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SPACE OPERATIONS

November 10, 1993
E613/RMP-FY94-310

George C. Marshall Space Flight Center
National Aeronautics and Space Administration
Marshall Space Flight Center, AL 35812

Attention Mr. V. K. Henson, SA51

Gentlemen:

Subject: Transmittal of Final Postflight Hardware Evaluation Report RSRM-28 (STS-53), TWR-64216 with Appendix A-E, DR 4-23, Type 2 Documentation

The subject document dated November 1993 has been prepared in accordance with DPD 400, Contract NAS8-38100, and copies are transmitted herewith in accordance with NASA/MSFC distribution requirements.

If you have any questions or comments concerning this transmittal, please direct them to the undersigned.

Very truly yours,

Robert M. Papasian
RSRM Data Manager

Encl: a/s

SPACE SHUTTLE
Solid Rocket Motor
Thiokol Corporation

TWR-64216

Final Postflight Hardware Evaluation Report RSRM-28 (STS-53)

November 1993

Prepared for:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER
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SPACE OPERATIONS

Final Postflight Hardware Evaluation Report RSRM-28 (STS-53)

November 1993

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Concurrence by:

Case Design

Joints & Seals Design

Integration Design

Nozzle Design

Igniter / Instrumentation /
Electrical Design

Thermal Insulation Design

Quality, Performance Evaluation

System Safety

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Acronym	Definition
CCP	Carbon Cloth Phenolic
CEI	Contract End Item
ET	External Tank
GCP	Glass Cloth Phenolic
HDI	High Density Indication
ID	Inside Diameter
IFA	In-Flight Anomaly
KSC	Kennedy Space Center
LDA	Low Density Anomaly
LDI	Low Density Indication
LH	Left Hand
NASA	National Aeronautics and Space Administration
OD	Outside Diameter
PEEP	Postflight Engineering Evaluation Plan
PFAR	Postfire Anomaly Record
PFOR	Postfire Observation Record
RH	Right Hand
RSRM	Redesigned Solid Rocket Motor
RTV	Room Temperature Vulcanized (Rubber)
S&A	Safe and Arm Device
SCP	Silica Cloth Phenolic
SII	SRM Ignition Initiator
SPR	Significant Problem Report
STS	Space Transportation System
TWR	Thiokol Wasatch Report

1.0 INTRODUCTION

This document is the final report for the Clearfield disassembly evaluation and a continuation of the KSC postflight assessment for the RSRM-28 (STS-53) RSRM flight set. All observed hardware conditions were documented on PFORs and are included in Appendices A through C. Appendices D and E contain the measurements and safety factor data for the nozzle and insulation components. This report, along with the KSC Ten-Day Postflight Hardware Evaluation Report (TWR-64215), represents a summary of the RSRM-28 hardware evaluation. The as-flown hardware configuration is documented in TWR-63638. Disassembly evaluation photograph numbers are logged in TWA-1989.

The RSRM-28 flight set disassembly evaluations described in this document were performed at the RSRM Refurbishment Facility in Clearfield, Utah. The final factory joint demate occurred on July 15, 1993. Additional time was required to perform the evaluation of the stiffener rings per Special Issue 4.1.5.2 because of the washout schedule. The release of this report was after completion of all Special Issues per Program Management direction.

Detailed evaluations were performed in accordance with the Clearfield PEEP, TWR-50051, Revision A. All observations were compared against limits that are also defined in the PEEP. These limits outline the criteria for categorizing the observations as acceptable, reportable, or critical. Hardware conditions that were unexpected and/or determined to be reportable or critical were evaluated by the applicable team and tracked through the PFAR system.

Figure 1 shows the RSRM Case Configuration.

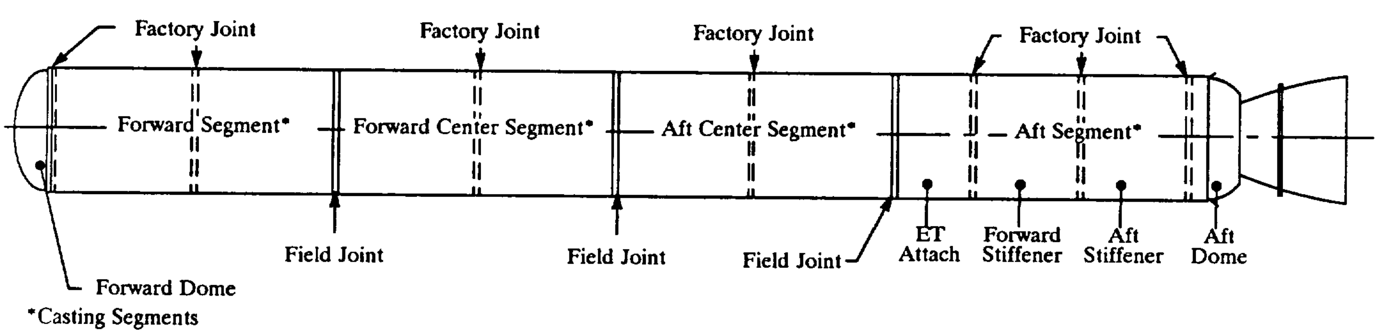


Figure 1. Case Configuration

2.0 REFERENCES

The following documents are referenced herein:

CPW1-3600A	Prime Equipment End Item Detail Specification, Part I of Two Parts; Performance, Design, and Verification Requirements, Space Shuttle Redesigned Solid Rocket Motor CPW1-3600 For Space Shuttle Solid Rocket Motor Project, Operational Flight Motors (RSRM-4 and subsequent)
TWA-1989	RSRM-28, STS-53, Clearfield Postflight Photo Log
TWR-50050	KSC Postflight Engineering Evaluation Plan (PEEP)
TWR-50051	Clearfield Postflight Engineering Evaluation Plan (PEEP)
TWR-63638	STS-53, RSRM-28, KSC Processing Configuration and Data Report
TWR-64213	Postflight Hardware Special Issues, RSRM-28 (STS-53), Clearfield
TWR-64215	KSC Ten-Day Postflight Hardware Evaluation Report, RSRM-28 (STS-53)
TWR-64217	RSRM-28 (STS-53) Postflight Assessment at KSC/Clearfield
TWR-64222	Final Postflight Hardware Evaluation Report, RSRM-29 (STS-54)

3.0 EVALUATION SUMMARY

Table I provides a summary of all postflight-related Squawks/Preliminary PFARs, PFARs, IFAs, and SPRs for RSRM-28.

Table I. Summary of RSRM-28 Problems

	Squawks/Prelim. PFARs	PFARs	IFAs	SPRs
KSC	12	7	0	0
Clearfield	12	4	0	0
Total	**24**	**11**	**0**	**0**

A list of all RSRM-28 PFARs is included in Table II. This includes Squawks (written at KSC) and Preliminary PFARs (written at Clearfield) that were written and not elevated to PFARs. Information relating to postflight Squawks can be found in TWR-64215.

3.1 CEI Specification Compliance

Based on hardware evaluations at KSC and Clearfield, as defined in the respective PEEPs (TWR-50050, Revision C and TWR-50051, Revision A), all CEI (CPW1-3600A) motor performance requirements were met.

Table II. Problem Summary for RSRM-28

PFAR/SQUAWK/ PRELIM. PFAR NUMBER	TYPE	ELEVATED FROM	SPR NUMBER	IFA NUMBER	EVALUATION LOCATION	COMPONENT	SPAT/ RPRB DATE	DESCRIPTION
53-010	SQUAWK	N/A	N/A	N/A	KSC	CASE	12/05/92	BUBBLED PAINT ON AFT SEGMENT CASE ACREAGE
53-011	SQUAWK	N/A	N/A	N/A	KSC	JPS/TPS	12/05/92	MISSING K5NA ON FJPS OF RH FORWARD FIELD JOINT
53-013	SQUAWK	N/A	N/A	N/A	KSC	NOZZLE	12/07/92	SPLASHDOWN DAMAGE TO JOINT 1 PRIMARY O-RING
53-014	SQUAWK	N/A	N/A	N/A	KSC	SEAL SURF.	12/09/92	CHATTER MARKS ON FEC (JOINT 1) SECONDARY SEAL SURFACE
53-030	SQUAWK	N/A	N/A	N/A	KSC	JPS/TPS	12/17/92	PITTING ON FORWARD SEGMENT TANG O.D. AT FIELD JOINT HEATER SPOT BOND LOCATIONS
53C-01	PRELIM.	N/A	N/A	N/A	H-5/H-7	NOZZLE	12/15/92	SLAG DAMAGE ON BEARING PROTECTOR AND FLEX BOOT
53C-02	PRELIM.	N/A	N/A	N/A	H-5/H-7	NOZZLE	12/16/92	BUBBLED PAINT ON FORWARD END RING
53C-03	PRELIM.	N/A	N/A	N/A	H-5/H-7	NOZZLE	12/16/92	BUBBLED PAINT ON FORWARD END RING
53C-05	PRELIM.	N/A	N/A	N/A	H-5/H-7	NOZZLE	12/16/92	BUBBLED PAINT ON THROAT HOUSING
53C-06	PRELIM.	N/A	N/A	N/A	H-5/H-7	NOZZLE	12/17/92	ABNORMAL FIXED HOUSING METAL-TO-ADHESIVE BONDLINE FAILURE MODE
53C-07	PRELIM.	N/A	N/A	N/A	H-5/H-7	NOZZLE	12/18/92	ABNORMAL FIXED HOUSING METAL-TO-ADHESIVE BONDLINE FAILURE MODE
53C-08	PRELIM.	N/A	N/A	N/A	H-5/H-7	IGNITER	12/21/92	THREAD DAMAGE ON ARMING MONITOR SAFING PIN RETAINER
53C-12	PRELIM.	N/A	N/A	N/A	H-5/H-7	INSULATION	03/24/93	FORWARD SEGMENT ACREAGE INSULATION COMPLIANCE SAFETY FACTOR VIOLATION
360L028A-01	PFAR	53-020	N/A	N/A	KSC	SEAL SURF.	12/23/92	SCRATCH ON FIXED HOUSING RADIAL BOLT HOLE SPOTFACE SEALING SURFACE
360L028A-02	PFAR	53-021	N/A	N/A	KSC	SEALS	12/23/92	GRINDING MARKS ON NOZZLE-TO-CASE JOINT PACKINGS WITH RETAINERS
360L028A-03	PFAR	53-022	N/A	N/A	KSC	NOZZLE	12/23/92	DAMAGE TO THREADED HOLE ON AFT EXIT CONE (JOINT 1)
360L028A-04	PFAR	53-026	N/A	N/A	KSC	SEAL SURF.	12/23/92	SCRATCH ON IGNITER ADAPTER SEAL SURFACE
360L028A-05	PFAR	53-027	N/A	N/A	KSC	SEAL SURF.	12/23/92	SCRATCHES ON AFT FIELD JOINT CLEVIS CAPTURE FEATURE SEAL SURFACE
360L028B-06	PFAR	53-028	N/A	N/A	KSC	SEALS	12/23/92	CIRCUMFERENTIAL ID SCRATCH ON AFT FIELD JOINT LEAK CHECK PLUG O-RING
360L028B-07	PFAR	53-029	N/A	N/A	KSC	CASE	12/23/92	INCORRECT FIELD JOINT SHIMS
360L028A-08	PFAR	53C-04	N/A	N/A	H-5/H-7	NOZZLE	12/23/92	BUBBLED PAINT ON THROAT HOUSING
360L028A-09	PFAR	53C-09	N/A	N/A	H-5/H-7	SEALS	12/23/92	CUT IN 126-DEGREE BARRIER-BOOSTER LEAK CHECK PLUG O-RING
360L028B-10	PFAR	53C-10	N/A	N/A	H-5/H-7	SEALS	12/23/92	CUT IN 126-DEGREE BARRIER-BOOSTER LEAK CHECK PLUG O-RING
360L028A-11	PFAR	53C-11	N/A	N/A	H-5/H-7	NOZZLE	02/10/93	SOFT ADHESIVE IN NOSE INLET ASSEMBLY BONDLINE

4.0 COMPONENT EVALUATIONS

The following sections detail, by component, the hardware conditions observed at Clearfield.

4.1 Insulation

Internal insulation evaluations of the igniters, case acreage, joints, and liners are summarized in the following sections. PFORs documenting the observations are found in Appendix A. Only the LH motor was evaluated as specified in the Clearfield PEEP.

4.1.1 Thermal Performance Evaluation

Summaries of the safety factors for the nozzle-to-case joint, field joint, factory joint, case acreage and igniter adapter insulation are found in Table III through Table VI, respectively. All safety factors for these areas can be found in Appendix E, Tables E-I through E-XI. All joint insulation regions, including factory joints, must meet a minimum safety factor of 2.0. A minimum safety factor of 1.5 is required in the acreage insulation regions.

Preliminary PFAR 53C-12 was written for an apparent CSF violation on the LH forward segment (see Table 5). The apparent violation occurred at the 371.0 inch station. The prefire data at that location appeared to be in error, resulting in an inflated material decomposition depth. All other safety factors were within CEI specification limits. All thermal protection requirements were met.

4.1.2 Internal Insulation Samples

The Clearfield PEEP specified that removal of standard insulation samples was not required on RSRM-28. Aft dome samples were removed per Special Issues (see Section 4.1.5.1).

Table III. Summary of RSRM-28 Nozzle-to-Case Joint and Field Joint Insulation Safety Factors

Joint	Min. Compliance Safety Factor (CSF) *	Degree Location	Min. Actual Safety Factor (ASF) *	Degree Location
Nozzle-to-Case Joint, LH	3.6	0.0, 46.8	4.1	0.0, 46.8
Aft Field Joint, LH	5.2	136.0	5.5	136.0
Center Field Joint, LH	14.5	136.0	15.3	136.0
Forward Field Joint, LH	15.3	90.0	16.2	90.0

* Minimum required joint insulation safety factor is 2.0.

Table IV. Summary of RSRM-28 Factory Joint Insulation Safety Factors

Joint	Station (inches)	Min. Compliance Safety Factor (CSF) *	Degree Location	Min. Actual Safety Factor (ASF) *	Degree Location
Aft Dome/ Stiffener, LH	56.0	3.83	0.0	4.57	0.0
Stiffener/ Stiffener, LH	177.7	2.62	0.0	4.00	0.0
Stiffener/ET Attach, LH	299.1	3.41	180.0	5.62	180.0
Aft Center, LH	161.4	2.88	270.0	7.38	270.0
Forward Center, LH	161.4	3.15	0.0	7.48	0.0
Forward Cylinder/ Cylinder, LH	162.0	2.91	154.0	4.16	154.0
Forward Dome/ Cylinder, LH	321.0	2.53	154.0	3.06	154.0

* Minimum required joint insulation safety factor is 2.0.

Table V. Summary of RSRM-28 Case Acreage Insulation Safety Factors

Segment	Min. Compliance Safety Factor (CSF) *	Station (inches)	Degree Location	Min. Actual Safety Factor (ASF) *	Station (inches)	Degree Location
Aft Dome, LH	2.63	45.0	46.8	2.89	33.0	270.0
Aft, LH	2.15	133.0	0.0	2.37	145.5	316.8
Aft Center, LH	2.23	11.0	46.0	3.03	11.0	46.0
Forward Ctr., LH	5.19	11.0	270.0	5.84	30.7	226.0
Forward, LH	1.10**	371.0	270.0	2.00	371.0	270.0

* Minimum required case acreage insulation safety factor is 1.5.

** Preliminary PFAR 53C-12 written for an apparent CSF violation

Table VI. Summary of RSRM-28 Igniter Adapter and Outer Joint Insulation Safety Factors

	Min. Compliance Safety Factor (CSF) *	Station	Degree Location	Min. Actual Safety Factor (ASF) *	Station	Degree Location
LH Adapter	2.40	11	180.0	2.87	11	180.0
RH Adapter	2.57	11	330.0	3.07	11	330.0
LH Outer Joint	3.38	403.0 in.	90.0	3.81	403.0 in.	90.0

* Minimum required safety factors are 1.5 for the igniter adapter acreage and 2.0 for the igniter joints.

4.1.3 Liner

Detailed liner maps are included in Appendix A. The remaining liner patterns were typical of past flight motors.

4.1.4 Igniter Nozzle Insert

LH

The postflight igniter nozzle insert throat diameter measurements were 6.350 inches at 0 degrees, 6.318 inches at 60 degrees, and 6.390 inches at 120 degrees. Using the maximum postfire measurement provides a thermal factor of safety of 8.7.

RH

The postflight igniter nozzle insert throat diameter measurements were 6.311 inches at 0 degrees, 6.360 inches at 60 degrees, and 6.305 inches at 120 degrees. Using the maximum postfire measurement provides a thermal factor of safety of 10.9.

4.1.5 Results of Special Issues and Concerns (Insulation)

TWR-64213 identified areas for special evaluation of RSRM-28 at Clearfield. The insulation issues are listed below with their respective results.

1. Condition: Density variations in the RSRM-29A aft dome C/F EPDM were noted during x-ray inspection. This condition is to be compared with a nominal layup such as RSRM-28. The RSRM-28 aft dome samples will be dissected and compared to RSRM-29A.

Results: Samples were removed from the LH aft dome at 0, 120, and 240 degrees. The aft segment was x-rayed preflight and was found to be normal with no density variations. These samples will be retained and compared with RSRM-29A. Results are to be documented in TWR-64222.

2. Condition: Chemlok primer and adhesive now extends to the ends of the stiffener rings (under the splice plates) so that all bare metal is covered.

Results: Five of the nine stiffener rings from the LH side and six of the nine from the RH side were washed out and evaluated at the Clearfield H-7 facility. The remaining seven stiffener rings had not yet been washed out and will not be evaluated. None of the eleven stiffener rings that were evaluated showed any evidence of corrosion in the Chemloked areas.

4.2 Case, Seals, and Joints

Seal and joint evaluations of the S&As, factory joints, internal nozzle joints, ports, and port plugs were performed. PFORs documenting the observations are found in Appendix B.

4.2.1 S&As

Figure 2 shows the Safe and Arm device (S&A) configuration. The S&As were disassembled on December 21, 1992 at the Clearfield H-5 facility.

One anomalous condition was observed. Minor thread damage (two small dings) was observed on the first thread of the safing pin retainer (arming monitor). Small metal shavings were present in the safing pin retainer cap. (See Preliminary PFAR 53C-08.)

4.2.2 Factory Joints

The factory joints were inspected by Quality Assurance at Clearfield. All fourteen factory joints were in good condition with no heavy corrosion reported on any of the joints. No O-ring heat effects or erosion were observed.

4.2.3 Internal Nozzle Joints

Details can be found in Section 4.3.

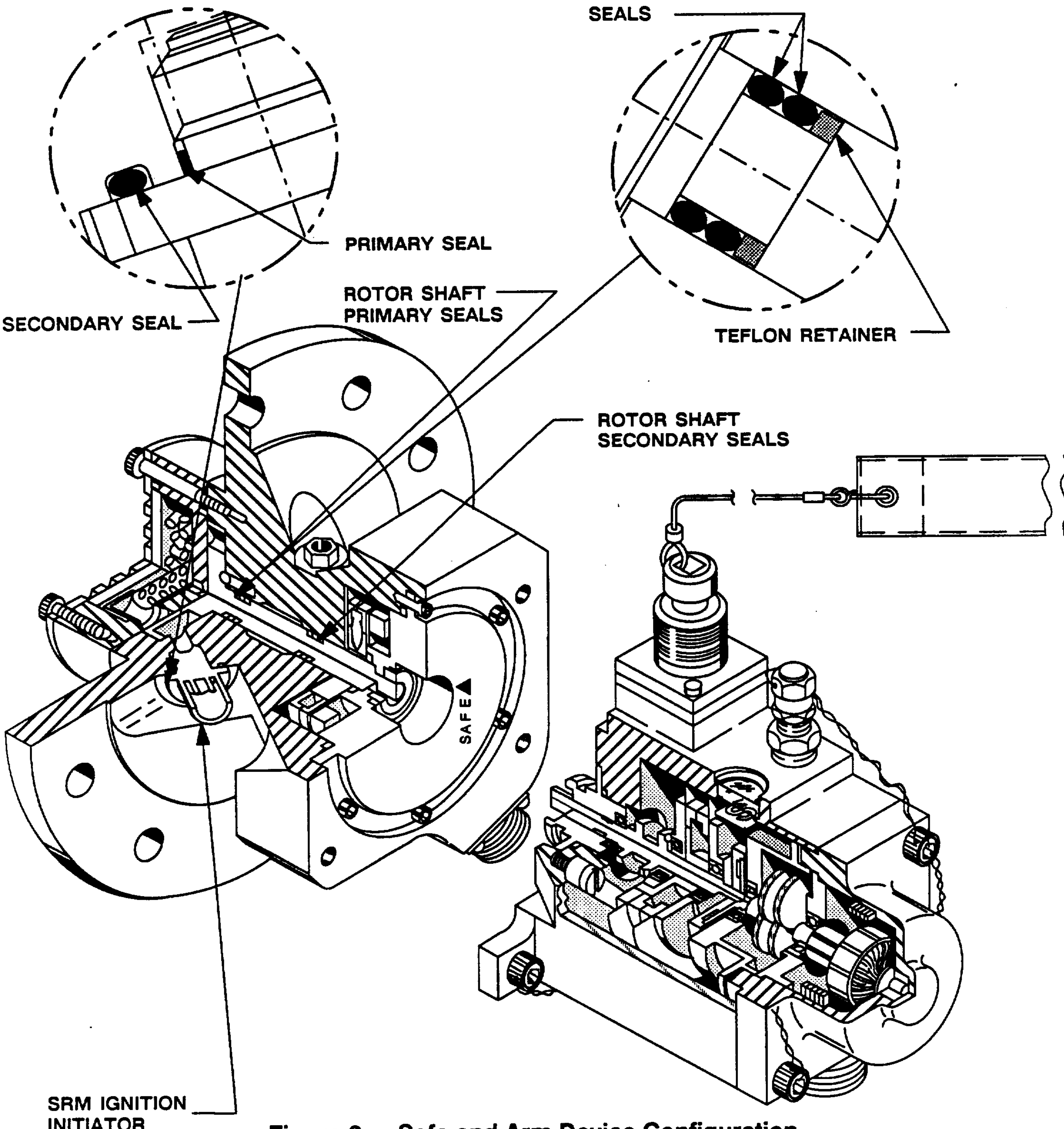


Figure 2. Safe and Arm Device Configuration

4.2.4 Ports and Port Plugs

Plug breakaway and running torques are documented on PFORs in Appendix B.

S&As
Two anomalous conditions were observed. Two cuts were seen on the LH 126–degree barrier–booster leak check plug O–ring OD. The first cut measured 0.015 inch long and did not leave a flap of material. The second cut left a flap of material and measured 0.025 inch circumferentially and 0.030 inch axially. (See Preliminary PFAR 53C–09.) One cut was observed on the RH 126–degree barrier–booster leak check plug O–ring OD. The cut measured 0.005 inch circumferentially and 0.010 inch axially. (See Preliminary PFAR 53C–10.)

Factory Joints
No anomalous conditions were observed on any of the factory joint leak check ports, plugs, or O–rings.

Internal Nozzle Joints
No anomalous conditions were observed on any of the internal nozzle joint leak check ports, plugs, or O–rings.

4.2.5 Results of Special Issues and Concerns (Case, Seals, and Joints)

TWR–64213 identified areas for special evaluation of RSRM–28 at Clearfield. The case, seals, and joints issues are listed below with their respective results.

1. Condition: Corrosion (pitting) has been documented in previous case Y–joint regions. Minimization of corrosion on future hardware is desirable.

Results: Assessment was not done.

2. Condition: The Joint 5 (LH) low pressure leak rate was the highest seen to date (0.076 sccs) but was within the specification limit (0.082 sccs).

Results: No anomalous conditions were observed and grease application was nominal.

3. Condition: The 306–degree leak check plug in the LH and RH Barrier–Booster housings (S&A joint) was removed at KSC. The plugs and ports were evaluated at KSC and observations were documented in the KSC Ten–Day Report (TWR–64215). Plastic protective caps were installed into the exposed ports.

Results: No further assessment of the LH or RH 306–degree leak plugs, ports, or O–rings was required at Clearfield.

4.3 Nozzle

Figure 3 shows the internal nozzle joint configuration. Also shown in Figure 3 are the materials used in the nozzle. The internal nozzle joints were disassembled on December 15 and 16, 1992 at the Clearfield H-6 facility.

The condition of the RSRM-28 nozzle internal joints was generally typical of previous flight nozzles. RTV was below the char line in all joints. The primary and secondary O-rings in all joints showed no signs of blowby, erosion, or heat effects. There was no significant metal hardware damage.

The following sections provide detailed assessments of nozzle internal joints, bondlines, char and erosion performance, flex boot, bearing protector, and flex bearing performance, and throat erosion data. The outcome of special issues and concerns for this nozzle flight set is also presented. PFORs documenting the observations are found in Appendices B and C.

4.3.1 Nose Inlet/Forward End Ring/Cowl (Joint 2)

LH

No anomalous conditions were observed. Typical scalloped shaped soot was observed to the bolt hole circle intermittently full circumference. Soot reached the primary O-ring intermittently full circumference. No O-ring or seal surface damage was observed, with the exception of one burnish mark caused by disassembly on the nose inlet housing secondary seal surface.

The forward end ring OD had intermittent bubbled paint full circumference (0.10 inch diameter maximum). Both the top coat and primer were bubbled. A clear liquid was present in the bubbles. There was no corrosion or signs of heat affect. (See Preliminary PFAR 53C-02.)

The RTV coverage was nominal with typical mixing of RTV and adhesive. Typical soot entered the joint between layers of RTV and adhesive.

Grease coverage on the joint metal surfaces was nominal. No excessive grease was found in the bolt holes. Medium-to-heavy corrosion was observed on the forward end chamfer of the cowl housing from 205-to-305 degrees. Intermittent medium-to-heavy corrosion was observed on the ID of cowl housing flange full circumference. Light corrosion was observed on the forward end ring flange forward face full circumference. No metal damage was observed.

No separations were observed on the cowl assembly or aft end of the nose cap.

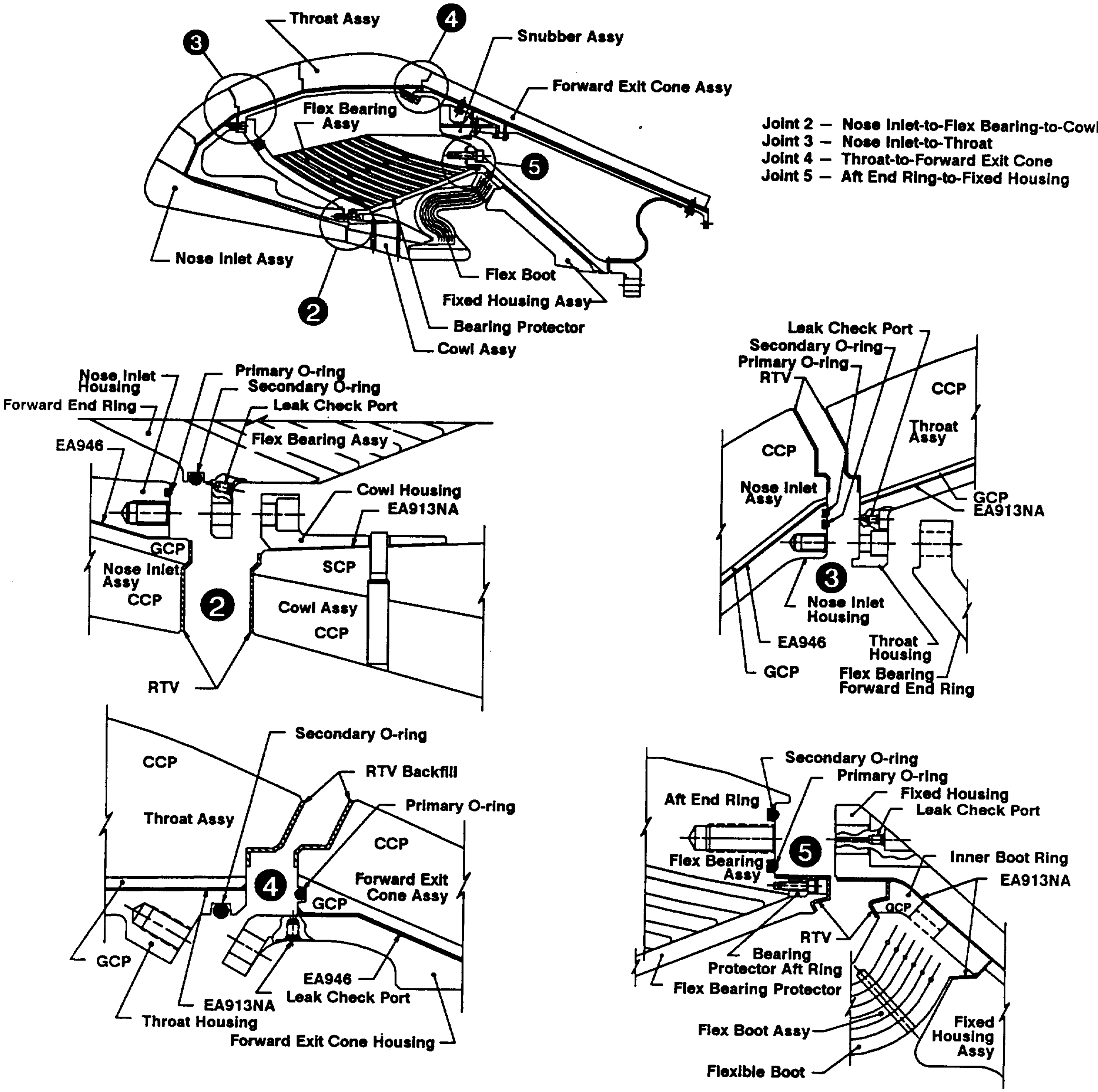


Figure 3. Internal Nozzle Joint Configuration

RH

No anomalous conditions were observed. Soot reached the primary O-ring intermittently from 90-to-185 degrees. No O-ring or seal surface damage was observed.

The forward end ring OD had intermittent bubbled paint full circumference (0.10 inch diameter maximum). Both the top coat and primer were bubbled. A clear liquid was present in the bubbles. There was no corrosion or signs of heat affect. (See Preliminary PFAR 53C-03.)

The RTV coverage was nominal with typical mixing of RTV and adhesive. Typical soot entered the joint between layers of RTV and adhesive.

Grease coverage on the joint metal surfaces was nominal. No excessive grease was found in the bolt holes. Medium-to-heavy corrosion was observed on the forward end chamfer of the cowl housing from 28-to-35, 93-to-118, 190-to-202, and 230-to-240 degrees. Intermittent medium-to-heavy corrosion was observed on the ID of the cowl housing flange full circumference. Intermittent light corrosion was observed on the forward end ring flange forward face outboard of the secondary O-ring groove. Intermittent light-to-medium corrosion was observed on the nose inlet housing aft face full circumference inboard of the secondary O-ring groove. No metal damage was observed.

No separations were observed on the cowl assembly or aft end of the nose cap.

4.3.2 Nose Inlet/Throat (Joint 3)

LH

One anomalous conditions was observed. No O-ring or seal surface damage was observed.

RTV was below the char line over the complete circumference. No gas paths were observed in the joint.

Grease coverage on the joint metal surfaces was nominal. No excessive grease was found in the bolt holes. Intermittent light-to-medium corrosion was observed inboard of the primary O-ring groove on both the nose inlet and throat housings. Intermittent bubbled paint (0.08 inch diameter maximum) was observed on the OD surface of the throat housing flange with clear fluid in the bubbles. Both the topcoat and primer were bubbled.No corrosion or signs of heat affect were present in the bubbled regions. (See Preliminary PFAR 53C-04.) No metal damage was observed.

No separations were observed on the nose inlet assembly. The forward end of the throat assembly was separated full circumference metal-to-adhesive with a maximum radial width of 0.010 inch.

RH

One anomalous condition was observed. No O–ring or seal surface damage was observed.

RTV was below the char line over the complete circumference. No gas paths were observed in the joint.

Grease coverage on the joint metal surfaces was nominal. No excessive grease was found in the bolt holes. Intermittent light–to–medium corrosion was observed inboard of the primary O–ring groove on both the nose inlet and throat housings. Intermittent bubbled paint (0.05 inch diameter maximum) was observed on the OD surface of the throat housing. No fluid was found in the bubbles. No corrosion or signs of heat affect were present in the bubbled regions. (See Preliminary PFAR 53C–05.) No metal damage was observed.

No separations were observed on the nose inlet assembly. The forward end of the throat assembly was separated full circumference metal–to–adhesive with a maximum radial width of 0.015 inch.

4.3.3 Throat/Forward Exit Cone (Joint 4)

LH

No anomalous conditions were observed. No O–ring or seal surface damage was observed.

RTV was below the char line over the complete circumference of the joint. No gas paths were observed in the joint. RTV reached the primary O–ring at 37.5–to–165 and 247.5–to–347.5 degrees. Grease did not interfere with the RTV backfill.

Grease coverage on the joint metal surfaces was nominal. No excessive grease was found in the bolt holes. Light–to–medium corrosion was observed on the throat housing between the primary and secondary O–rings full circumference. Light–to–medium corrosion was observed on the forward exit cone between the phenolic and secondary O–ring footprint full circumference. No metal damage was observed.

The forward end of the forward exit cone assembly was separated metal–to–adhesive at 262.5–0–247.5 degrees with a maximum radial width of 0.050 inch. The aft end of the throat assembly was separated full circumference metal–to–adhesive with a maximum radial with of 0.010 inch.

RH

No anomalous conditions were observed. No O-ring or seal surface damage was observed.

RTV was below the char line over the complete circumference of the joint. No gas paths were observed in the joint. RTV reached the primary O-ring at 105-to-362.5 degrees. Grease did not interfere with the RTV backfill.

Grease coverage on the joint metal surfaces was nominal. No excessive grease was found in the bolt holes. Light corrosion was observed on the throat housing between the primary and secondary O-rings intermittently full circumference. Intermittent light-to-medium corrosion was observed on the forward exit cone between the phenolic and secondary O-ring footprint intermittently full circumference. No metal damage was observed.

The forward end of the forward exit cone assembly was separated metal-to-adhesive at 200-310 degrees with a maximum radial width of 0.040 inch. The aft end of the throat assembly was separated full circumference metal-to-adhesive with a maximum radial with of 0.010 inch.

4.3.4 Flex Bearing/Fixed Housing (Joint 5)

LH

One anomalous condition was observed. No metal damage or rounded chamfers were observed on the Packing with Retainer spotfaces. Metal shavings were observed on several of the bolts towards the end of the bolt near the Nylok patch. All 72 Packings with Retainers had typical disassembly damage to the elastomer. No O-ring or seal surface damage was observed.

The RTV coverage was nominal with intermittent voids due to the assembly process. No gas paths were observed in the joint. RTV was observed to the primary O-ring at 20-to-85 and 205-to-260 and degrees.

Grease coverage on the joint metal surfaces was nominal. No excessive grease was found in the bolt holes. Intermittent medium corrosion was observed on the in-board aft tip of the aft end ring full circumference. No metal damage was observed

No separations were observed between the inner boot ring and the fixed housing.

Bubbles were observed on the ID surface of the cowl segments at 90-to-170 degrees. The mode of separation was 10 percent metal-to-adhesive, 70 percent adhesive-to-segments, and 20% cohesive within the segments.

There was typical even sooting on the bearing protector and the flex boot ID. Erosion was observed on the bearing protector aft of the belly band at 150 and 178–to–185 degrees. Corresponding areas were also observed on the flex boot in the same locations. It appeared that slag was trapped between the boot and bearing protector. Slag was found in the boot cavity. (See Preliminary PFAR 53C–01.)

RH

No anomalous conditions were observed. No metal damage or rounded chamfers were observed on the Packing with Retainer spotfaces. All 72 Packings with Retainers had typical disassembly damage to the elastomer. No O–ring or seal surface damage was observed.

The RTV coverage was nominal with intermittent voids due to the assembly process. No gas paths were observed in the joint. RTV was observed to the primary O–ring at 170–to–195 and 335–0–8 degrees.

Grease coverage on the joint metal surfaces was nominal. No excessive grease was found in the bolt holes. Intermittent medium corrosion was observed on the in–board aft tip of the aft end ring full circumference. No metal damage was observed.

No separations were observed between the inner boot ring and the fixed housing.

Bubbles were observed on the ID surface of the cowl segments at 195–to–210 and 355–0–55 degrees. The mode of separation was 10 percent metal–to–adhesive, 85 percent adhesive–to–segments, and 5% cohesive within the segments.

There was typical even sooting on the bearing protector and the flex boot ID.

4.3.5 Aft Exit Cone Assembly Bondlines

LH

The primary mode of separation was 100 percent within the GCP. The secondary mode was 6.25 percent metal–to–adhesive, 1.25 percent within the adhesive, and 92.5 percent adhesive–to–GCP. No corrosion was observed on the aft exit cone shell. Seven adhesive voids were observed with a diameter greater than 0.5 inch. Intermittent small voids (0.15 inch diameter maximum) were seen throughout the polysulfide. One "V"–shaped void was observed at 195 degrees and extended 0.40 inch maximum forward from the aft end of the groove.

RH

The primary mode of separation was 100 percent within the GCP. The secondary mode was 4.75 percent metal–to–adhesive, 1.75 percent within the adhesive, and 93.5 percent adhesive–to–GCP. No corrosion was observed on the aft exit cone shell. Ten adhesive voids were observed with a diameter greater than 0.5 inch. Intermittent small voids (0.10 inch diameter maximum) were seen throughout the polysulfide.

4.3.6 Forward Exit Cone Assembly Bondlines

LH

The mode of separation was 11.25 percent metal–to–adhesive, 15 percent within the adhesive, and 73.75 percent adhesive–to–GCP. Medium–to–heavy corrosion was present on the forward exit cone housing in areas of metal–to–adhesive separation. Ten adhesive voids were observed with a diameter greater than 0.5 inch.

RH

The mode of separation was 8.25 percent metal–to–adhesive, 15 percent within the adhesive, and 76.75 percent adhesive–to–GCP. Medium–to–heavy corrosion was present on the forward exit cone housing in areas of metal–to–adhesive separation. Thirteen adhesive voids were observed with a diameter greater than 0.5 inch.

4.3.7 Throat Assembly Bondlines

LH

The throat inlet ring and throat ring mode of separation was 98.4 percent metal–to–adhesive and 1.6 percent adhesive–to–GCP. Medium–to–heavy corrosion was present on the throat housing full circumference except in the areas of adhesive–to–GCP bondline separation. Two adhesive voids were observed with a diameter greater than 0.5 inch.

RH

The throat inlet ring and throat ring mode of separation was 95 percent metal–to–adhesive, 0.6 percent adhesive–to–GCP, and 4.4 percent GCP–to–CCP. Medium–to–heavy corrosion was present on the throat housing full circumference. Four adhesive voids were observed with a diameter greater than 0.5 inch.

4.3.8 Nose Inlet Rings (-503, -504) Bondlines

LH

The aft inlet ring and forward nose ring mode of separation was 98.75 percent metal-to-adhesive and 1.25 percent adhesive-to-GCP. Medium-to-heavy corrosion was present over 98 percent of the bondline. Three adhesive voids were observed with a diameter greater than 0.5 inch.

A brownish clear, tacky, foreign material was observed in an adhesive void on the forward nose ring-to-housing interface at 344 degrees (see Preliminary PFAR 53C-11).

RH

The aft inlet ring and forward nose ring mode of separation was 96.25 percent metal-to-adhesive, 0.63 percent within the adhesive, and 3.12 percent adhesive-to-GCP. Medium-to-heavy corrosion was present over 95 percent of the bondline. Two adhesive voids were observed with a diameter greater than 0.5 inch.

4.3.9 Nose Cap Bondlines

LH

The primary mode of separation was 5 percent within GCP and 95 percent CCP-to-GCP. The secondary mode of separation was 27 percent metal-to-adhesive, 0.5 percent within the adhesive, and 72.5 percent adhesive-to-GCP. Light-to-medium corrosion was present on the nose inlet housing on the forward 1.0 inch maximum intermittently around 75 percent of the circumference and aft 3.25 inches maximum full circumference. No adhesive voids were observed with a diameter greater than 0.5 inch.

RH

The primary mode of separation was 100 percent GCP-to-CCP. The secondary mode of separation was 22.5 percent metal-to-adhesive and 77.5 percent adhesive-to-GCP Light-to-medium corrosion was present on the nose inlet housing on the aft 2.75 inches maximum full circumference and on the forward 1.0 inch maximum intermittently around 60 percent of the circumference. No adhesive voids were observed with a diameter greater than 0.5 inch.

4.3.10 Cowl Bondlines

LH

The mode of separation was 100 percent metal–to–adhesive. Medium–to–heavy corrosion was present on the cowl housing full circumference. Three adhesive voids were observed with a diameter greater than 0.5 inch.

RH

The mode of separation was 100 percent metal–to–adhesive. Medium–to–heavy corrosion was present on the cowl housing full circumference. Five adhesive voids were observed with a diameter greater than 0.5 inch.

4.3.11 Fixed Housing Assembly Bondlines

LH

The mode of separation was 39 percent metal–to–adhesive, 40 percent adhesive–to–GCP, and 21 percent within GCP. Preliminary PFAR 53C–06 was written because the metal–to–adhesive separation exceeded 15 percent. The secondary mode of separation was 2.5 percent metal–to–adhesive and 97.5 adhesive–to–GCP. Four indications were detected with ultrasonic inspection. Two of the four indications were found during bondline evaluation. No corrosion was observed on the housing. Nine adhesive voids were observed with a diameter greater than 0.5 inch. Intermittent adhesive voids with diameters of 0.30 inch or smaller were also seen.

RH

The primary mode of separation was 54.5 percent metal–to–adhesive, 21.75 percent adhesive–to–GCP, and 23.75 percent within GCP. Preliminary PFAR 53C–07 was written because the metal–to–adhesive separation exceeded 15 percent. The secondary mode of separation was 10 percent metal–to–adhesive and 90 percent adhesive–to–GCP. Eight indications were detected with ultrasonic inspection. Two of the eight indications were found during bondline evaluation. No corrosion was observed on the housing. Three adhesive voids were observed with a diameter greater than 0.5 inch.

4.3.12 Ultrasonic Inspection of Fixed Housing Assemblies

Ultrasonic inspection was conducted on both of the fixed housing assemblies. Four indications were found on the LH fixed housing and eight indications were found on the RH fixed housing. A summary of the ultrasonic inspection results/maps is documented in memo 8272–FY93–M093.

4.3.13 Char and Erosion Performance

Char and erosion margins of safety are summarized in Table VII. The char and erosion data tables for each component liner can be found in Tables D–I through D–XII of Appendix D. Measurement stations that contain an "NA" means that data was not available due to missing material. The aft exit cone liners were not recovered and therefore are not included. All stations showed positive margins of safety. The measurement stations can be found in Figure D–1.

Table VII. RSRM–28 Nozzle Char and Erosion Minimum Margins of Safety Summary

Hardware	Stations*												
Forward Exit Cone Assembly, LH	**1**	**4**	**4.6**	**8**	**12**	**16**	**20**	**24**	**28**	**32**	**32.9**	**34**	
	0.26	0.25	0.23	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Forward Exit Cone Assembly, RH	**1**	**4**	**4.6**	**8**	**12**	**16**	**20**	**24**	**28**	**32**	**32.9**	**34**	
	0.28	0.30	0.25	0.16	0.49	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Throat Assembly, LH	**1**	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**23**
	0.23	0.16	0.22	0.16	0.08	0.20	0.26	0.31	0.39	0.32	0.43	0.57	0.40
Throat Assembly, RH	**1**	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**23**
	0.13	0.17	0.17	0.11	0.07	0.17	0.23	0.27	0.38	0.37	0.45	0.46	0.32
Nose Inlet Rings (–503, –504), LH	**28**	**30**	**32**	**34**	**36**	**38**	**39**						
	0.10	0.23	0.18	0.38	0.32	0.14	0.08						
Nose Inlet Rings (–503, –504), RH	**28**	**30**	**32**	**34**	**36**	**38**	**39**						
	0.14	0.28	0.17	0.32	0.32	0.15	0.12						
Nose Cap, LH	**1.5**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**24**	**26**
	0.43	0.46	0.52	0.61	0.61	0.69	0.63	0.60	0.55	0.47	0.11	0.02	0.09
Nose Cap, RH	**1.5**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**24**	**26**
	N/A	0.49	0.67	0.68	0.77	0.77	0.83	0.81	0.77	0.58	0.20	0.09	0.21
Cowl/OBR, LH	**0.3**	**1**	**2**	**3**	**4**	**5**	**6**	**6.8**	**8**	**9**	**10**	**11.3**	
	0.15	0.11	0.10	0.19	0.21	0.31	0.41	N/A	0.22	0.41	0.48	0.51	
Cowl/OBR, RH	**0.3**	**1**	**2**	**3**	**4**	**5**	**6**	**6.8**	**8**	**9**	**10**	**11.3**	
	0.26	0.24	0.20	0.21	0.24	N/A	N/A	N/A	0.30	0.42	0.51	0.38	
Fixed Housing Assembly, LH	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10.75**		
	1.80	0.87	0.62	0.72	0.83	0.89	1.04	1.08	1.27	2.37	0.66		
Fixed Housing Assembly, RH	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10.75**		
	1.88	0.64	0.79	0.76	0.78	0.78	0.83	0.99	1.16	1.48	0.67		

* Station locations are shown in bold with the margin of safety shown below.

4.3.14 Flex Boot Performance

The performance of both the LH and RH flex boots was nominal. The LH flex boot had a minimum of 3.0 NBR plies intact and the RH flex boot had a minimum of 3.0 NBR plies intact. Positive margins of safety were achieved at all measurement stations. The flex boot performance margins of safety are summarized in Table VIII.

Table VIII. RSRM-28 Flex Boot Margins of Safety

	Left Hand			Right Hand		
Degree Location	Remaining Plies	Max. Material Affected Depth (in.)	Performance Margin of Safety	Remaining Plies	Max. Material Affected Depth (in.)	Performance Margin of Safety
0	3.8	1.14	0.46	3.2	1.34	0.24
90	3.1	1.37	0.21	3.0	1.40	0.19
180	3.8	1.14	0.46	3.7	1.17	0.42
270	3.0	1.40	0.19	3.1	1.37	0.21

* Minimum flex boot overall prefire thickness is 2.5 inches.

4.3.15 Bearing Protector Performance

Both the LH and RH bearing protectors performed as expected during flight. Both bearing protectors were evenly sooted around the full circumference and showed typical greater erosion in–line with the cowl vent holes. There was no evidence of soot or heat effect on the flex bearing side of either bearing protector. PFOR C–9 shows the postflight bearing protector thickness measurements every ten degrees.

4.3.16 Flex Bearing Performance

LH

The flex bearing performance during flight was acceptable. Examination of the flex bearing revealed no damage, soot, heat effect, or flow indications.

RH

The flex bearing performance during flight was acceptable. Examination of the flex bearing revealed no damage, soot, heat effect, or flow indications.

4.3.17 Throat Diameter

The average LH nozzle postfire throat diameter was 55.960 inches (erosion rate of 8.53 mils/sec based on an action time of 123.1 sec). The average RH nozzle postfire throat diameter was 55.954 inches (erosion rate of 8.49 mils/sec based on an action time of 123.3 sec). RSRM postfire throat diameters have ranged from 55.787 to 56.072 inches.

4.3.18 Results of Special Issues and Concerns (Nozzle)

TWR-64213 identified areas for special evaluation of RSRM-28 at Clearfield. The nozzle issues are listed below with their respective results.

1. **Condition:** Cuts were present in the RH flex boot rubber adjacent to the forward end of the inner boot ring. The cuts ran from 0-to-225 degrees and 300-to-359 degrees and were approximately 0.100 inch maximum depth.

   Results: No evidence of abnormal separation or signs of cut propagation were observed.

2. **Condition:** LDIs were found at the RH forward nose ring GCP-to-housing interface.

   Results: A small adhesive void (0.10 inch diameter) found at 282 degrees did not correlate well with the size of the reported LDA at 283 degrees.

3. **Condition:** LDIs were found at the RH nose cap GCP-to-housing interface.

   Results: A void observed at 178 degrees correlated closely with the reported LDA at 177 degrees. No voids were observed at 244 degrees, but the hydrolase may have destroyed adhesive evidence on the nose cap.

4. **Condition:** LDIs were found at the RH nose cap-to-forward nose ring interface.

   Results: Voids in the nose cap at 13 and 267 degrees correlated closely with the reported LDAs. All other LDAs could not be found. All were in or near the char and erosion area.

5. **Condition:** LDIs were found at the LH nose cap-to-forward nose ring interface.

   Results: Voids were observed at 0, 81, and 295 degrees. The size of the voids does not correlate well with the reported LDAs but are at the char line and may have extended forward where the evidence may have eroded off.

6. **Condition:** An HDI was found at the LH nose cap-to-forward nose ring interface.

   Results: No evidence of the HDI was observed.

7. **Condition:** LDIs were found at the RH cowl SCP-to-housing interface.

   Results: All LDIs were found to be adhesive voids.

8. **Condition:** LDIs were found at the LH cowl SCP-to-housing interface.

   Results: Three of the five reported LDIs were found to be adhesive voids.

9. Condition: The LH outer boot ring had a wet line indication at 358 degrees on the aft end. The defect measured 0.300 inch circumferentially x 0.010 inch radially. The wetline was removed by hand sanding and was blended to a smooth contour. The blended area measured 1.30 inches circumferentially x 0.40 inch radially x 0.034 inch deep.

Results: No abnormal erosion was observed at the 358 degree location.

TWR-64216

Appendix A
Insulation PFORs

Final Postflight Hardware Evaluation Report
RSRM-28 (STS-53)

November 1993

Prepared for:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER
MARSHALL SPACE FLIGHT CENTER, ALABAMA 35812

Contract No.	NAS8-38100
DR No.	4-23
WBS No.	4C601-04-01
ECS No.	SS4771

Thiokol CORPORATION
SPACE OPERATIONS

P.O. Box 707, Brigham City, Utah 84302-0707 (801) 863-3511

INSULATION REQUIRED PFOR LIST

PFOR #	Title	Side	Joint or Location	Final Report Page Number
A–1	Postfire Insulation CPI Log Numbers	Left	N/A	A–1
A–2	Segment Internal Insulation Condition	Left	Forward Segment	A–2
A–2	Segment Internal Insulation Condition	Left	Forward Center Segment	A–3
A–2	Segment Internal Insulation Condition	Left	Aft Center Segment	A–4
A–2	Segment Internal Insulation Condition	Left	Aft Segment	A–5
A–3	Forward Segment Liner Pattern	Left	Forward Segment	A–6
A–4	Forward Center Segment Liner Pattern	Left	Forward Center Segment	A–7
A–5	Aft Center Segment Liner Pattern	Left	Aft Center Segment	A–8
A–6	Aft Segment Liner Pattern	Left	Aft Segment	A–9
A–8	Igniter Nozzle Insert Throat Diameter Measurements	Left	Igniter Nozzle Insert	A–10
A–9	Stiffener Ring Condition	Left	Stiffener Rings	A–11

(Note: Clarification forms will be inserted after the required PFOR in the Final Report. The clarification form page number will be the same as the required PFOR Final Report page number appended by a sequential alphabetic extension.)

INSULATION REQUIRED PFOR LIST (Cont.)

PFOR #	Title	Side	Joint or Location	Final Report Page Number
A-1	Postfire Insulation CPI Log Numbers	Right	N/A	A-12
A-2	Segment Internal Insulation Condition	Right	Forward Segment	A-13
A-2	Segment Internal Insulation Condition	Right	Forward Center Segment	A-14
A-2	Segment Internal Insulation Condition	Right	Aft Center Segment	A-15
A-2	Segment Internal Insulation Condition	Right	Aft Segment	A-16
A-8	Igniter Nozzle Insert Throat Diameter Measurements	Right	Igniter Nozzle Insert	A-17
A-9	Stiffener Ring Condition	Right	Stiffener Rings	A-18

(Note: Clarification forms will be inserted after the required PFOR in the Final Report. The clarification form page number will be the same as the required PFOR Final Report page number appended by a sequential alphabetic extension.)

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-1
Postfire Insulation Common Planning Index (CPI) Log Numbers

Motor No.: 360T028	Side: Left (A)	Date: 21 JULY 1993
Assessment Engineer(s)/Inspector(s): NORM EDDY		

Record CPI Log and Postfire Part and Serial Numbers Below:

	P/N	PPC No.	Serial No.	CPI Log No.
A. Igniter Chamber	N/A	N/A	N/A	N/A
B. Igniter Adapter	1U77457-01	903	9	4CIBH
C. Forward Segment	1U76790-05	904	13	4CFWL
D. Forward Center Segment	1U76791-01	903	27	4CFWM
E. Aft Center Segment	1U76791-01	903	26	4CFWM
F. Aft Segment	1U76957-03	904	13	4CFWN

Notes / Comments

Clarification Form(s)? ______ Yes __✓__ No   Clarification Form Page No.(s): ________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-2
Segment Internal Insulation Condition (After Low Pressure Rinse)

Motor No.: 360T028	Side: Left (A)	Date: 3/19/93
Assessment Engineer(s)/Inspector(s): Reo Mackley		
Segment: Forward		

Segment Internal Insulation Observations:

	Yes	No	Comment #
A. Abnormal Erosion?		✓	
B. Gas Paths?		✓	
C. Ply Separations?		✓	
D. Abnormal Blisters?		✓	
E. Abnormal Cuts or Gouges?	✓		1
F. Foreign Material Within Insulation?		✓	
G. Non-Uniformities in the Eleven Point Burn-out Pattern? (Forward Segment Only)		✓	

Notes / Comments

1) A spiral pattern was worn into the insulation during the postfire rinse. The depth ranges approximately between ~~0 and~~ .005 to .0030. The distance between spirals is about 9 inches. This will have no significant impact on insulation measurement. This occurrence is documented on Process Departure no. 414869.

2) CSF VIOLATION @ 371.0" STATION, 270°

Preliminary PFAR(s)? ✓ Yes ___ No   Preliminary PFAR Number(s): 53C-12

Clarification Form(s)? ___ Yes ✓ No   Clarification Form Page No.(s): ______

DOC NO. TWR-64216 VOL
SEC PAGE A-2

REVISION ___

POSTFLIGHT OBSERVATION RECORD (PFOR) A-2
Segment Internal Insulation Condition (After Low Pressure Rinse)

Motor No.: 360T028	Side: Left (A)	Date: 11 June 93
Assessment Engineer(s)/Inspector(s): Rec Mackley		
Segment: Forward Center		

Segment Internal Insulation Observations:	Yes	No	Comment #
A. Abnormal Erosion?		✓	
B. Gas Paths?		✓	
C. Ply Separations?		✓	
D. Abnormal Blisters?		✓	
E. Abnormal Cuts or Gouges?		✓	
F. Foreign Material Within Insulation?		✓	
G. Liner Completely Missing? (Center Segments Only)		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-2
Segment Internal Insulation Condition (After Low Pressure Rinse)

Motor No.: 360T028	**Side:** Left (A)	**Date:** ?-21-93
Assessment Engineer(s)/Inspector(s): Reo Mackley		
Segment: Aft Center		

Segment Internal Insulation Observations:	Yes	No	Comment #
A. Abnormal Erosion?		✓	
B. Gas Paths?		✓	
C. Ply Separations?		✓	
D. Abnormal Blisters?		✓	
E. Abnormal Cuts or Gouges?		✓	
F. Foreign Material Within Insulation?		✓	
G. Liner Completely Missing? (Center Segments Only)		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No **Preliminary PFAR Number(s):** ______

Clarification Form(s)? ______ Yes ✓ No **Clarification Form Page No.(s):** ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-2

Segment Internal Insulation Condition (After Low Pressure Rinse)

Motor No.: 360T028	Side: Left (A)	Date: 3/8/93
Assessment Engineer(s)/Inspector(s): Rio Markley		
Segment: Aft		

Segment Internal Insulation Observations:	Yes	No	Comment #
A. Abnormal Erosion?		✓	
B. Gas Paths?		✓	
C. Ply Separations?		✓	
D. Abnormal Blisters?		✓	
E. Abnormal Cuts or Gouges?		✓	
F. Foreign Material Within Insulation?		✓	
G. NBR Under the CF/EPDM Exposed in the Aft Dome?		✓	

Notes / Comments

Special Issue 3.1.1.1:

aft dome samples have been removed.
SAMPLES TO BE USED IN COMPARISON OF RSRM-29 SAMPLES.

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ________

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ________

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

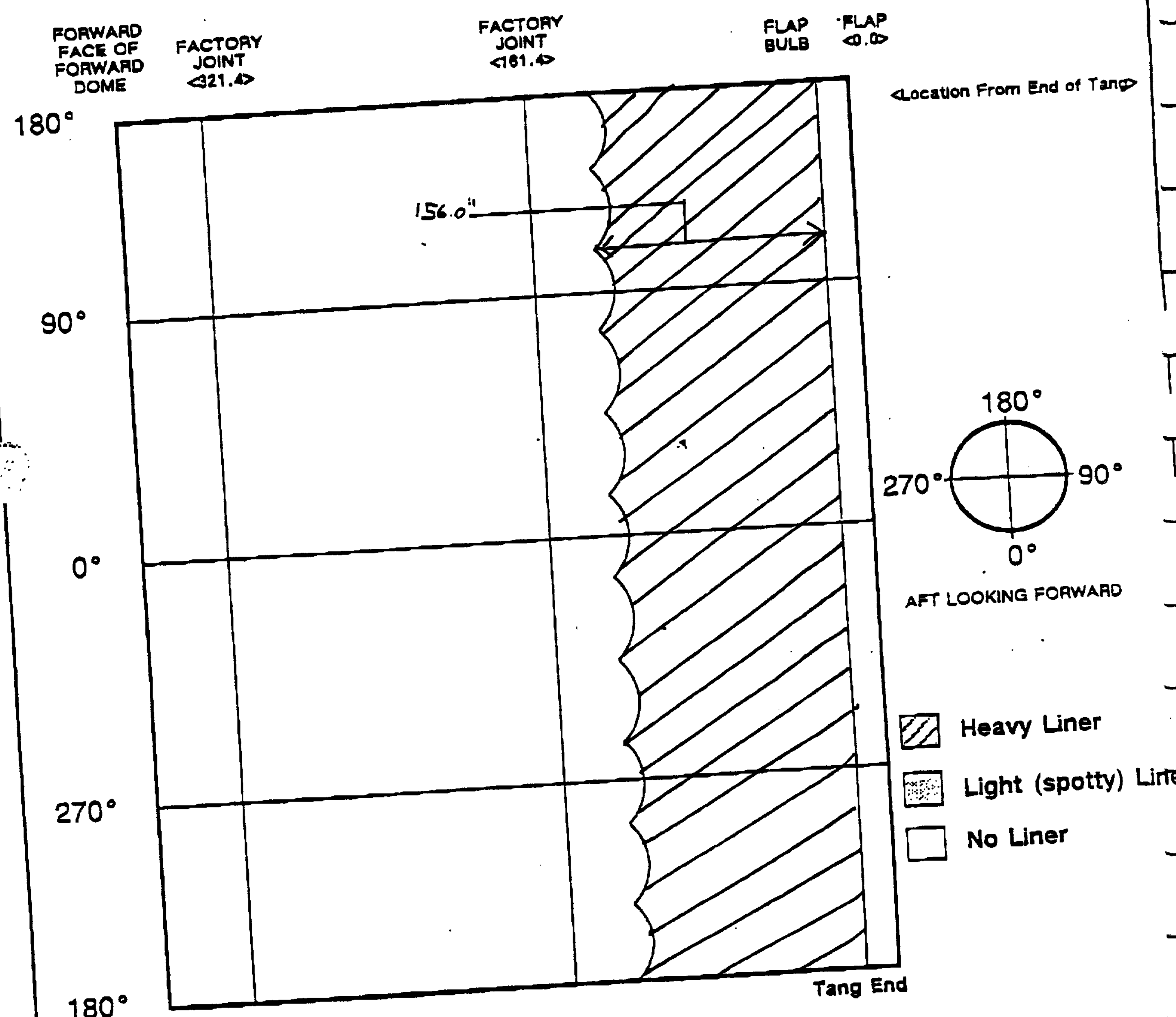
POSTFLIGHT OBSERVATION RECORD (PFOR) A-3

Forward Segment Liner Pattern (Data Collection Only)

Motor No.: RSRM 28A	Side: Left (A)	Date: 3-18-93

Assessment Engineer(s)/Inspector(s): Scott Spencer

Sketch Forward Segment Liner Pattern Observations Below:



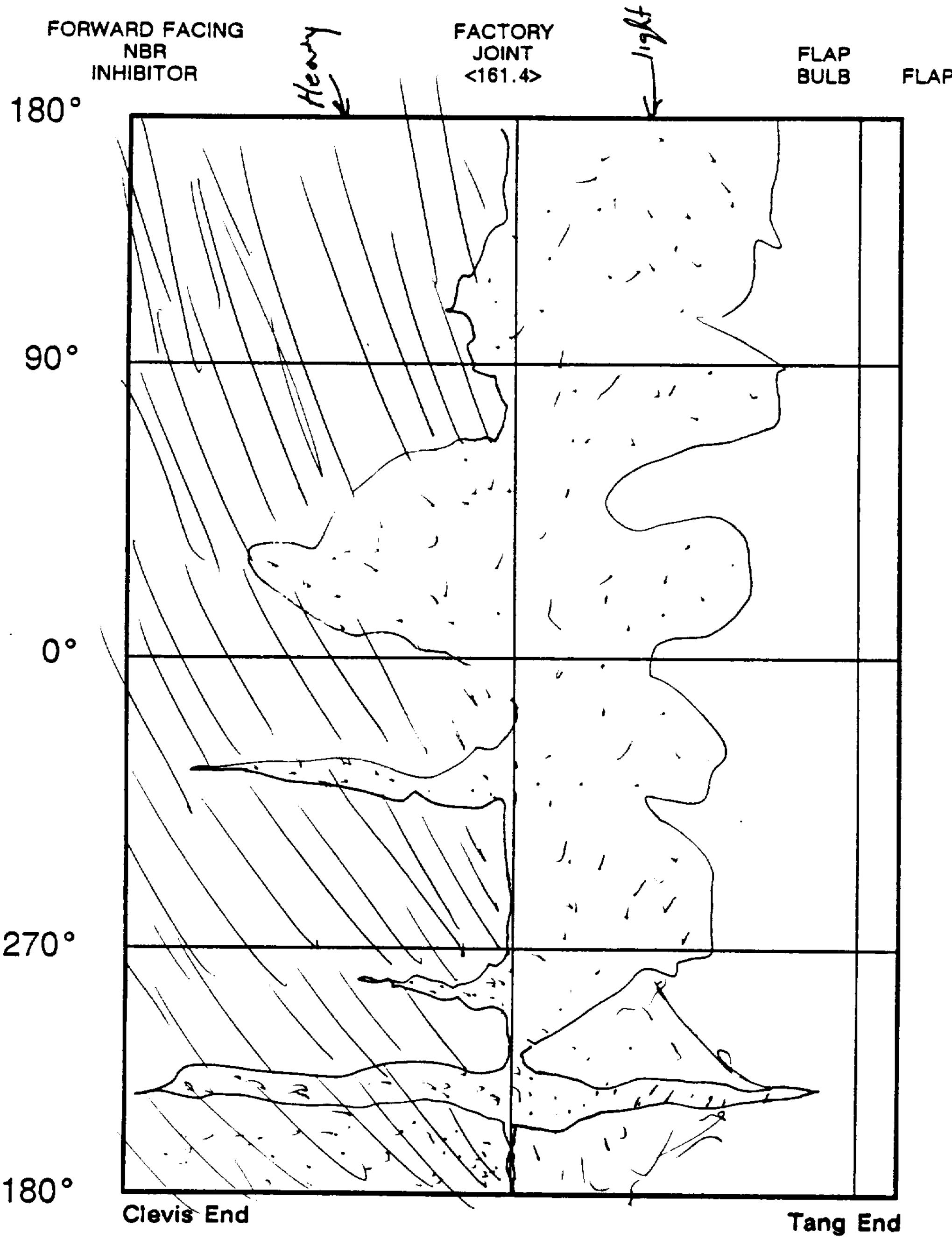
Clarification Form(s)? ______ Yes ✓ No

Clarification Form Page No.(s): ______

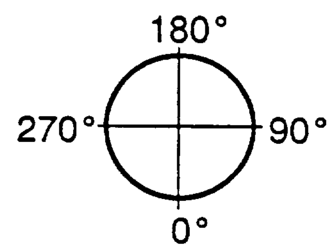
POSTFLIGHT OBSERVATION RECORD (PFOR) A-4
Forward Center Segment Liner Pattern (Data Collection Only)

Motor No.: 360T028	Side: LEFT (A)	Date: 6-15-93
Assessment Engineer(s)/Inspector(s): Thalman		

Sketch Forward Center Segment Liner Pattern Observations Below:



<Location From End of Tang>



AFT LOOKING FORWARD

- Heavy Liner
- Light (spotty) Liner
- No Liner

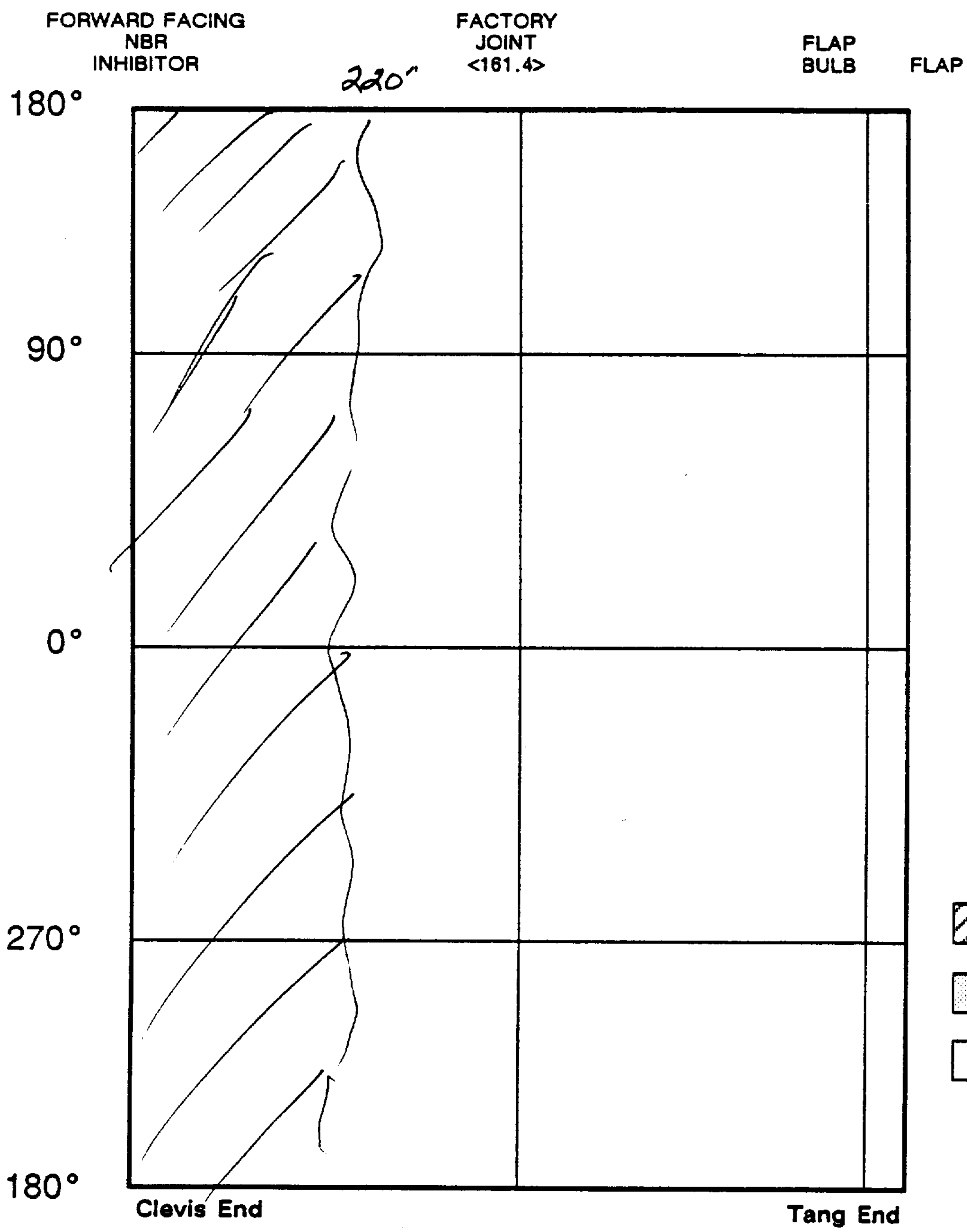
Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ____________

Thiokol CORPORATION
SPACE OPERATIONS

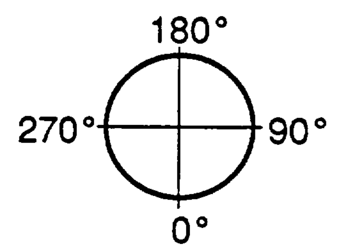
POSTFLIGHT OBSERVATION RECORD (PFOR) A-5
Aft Center Segment Liner Pattern (Data Collection Only)

Motor No.: 360T028	Side: LEFT (A)	Date: 6-18-93
Assessment Engineer(s)/Inspector(s): Thalman		

Sketch Aft Center Segment Liner Pattern Observations Below:



<Location From End of Tang>



AFT LOOKING FORWARD

- Heavy Liner
- Light (spotty) Liner
- No Liner

Clarification Form(s)? ______ Yes __✓__ No   Clarification Form Page No.(s): ______________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-6
Aft Segment Liner Pattern (Data Collection Only)

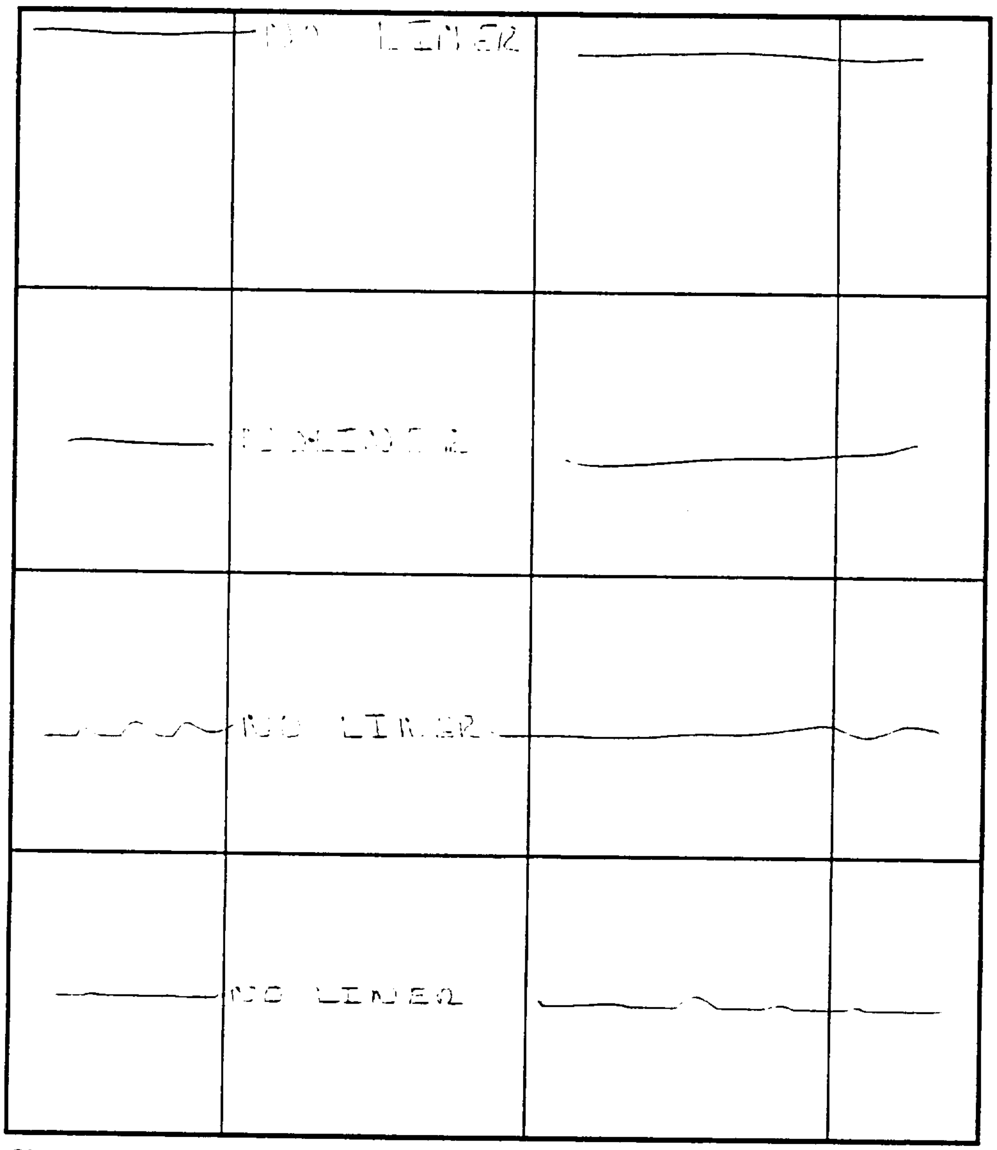
Motor No.: 360T028	Side: LEFT (A)	Date: 03-03-93
Assessment Engineer(s)/Inspector(s): [illegible]		

Sketch Aft Segment Liner Pattern Observations Below:

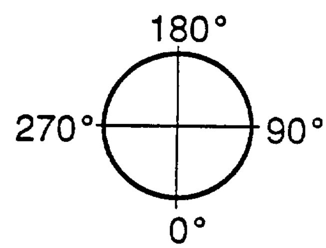
FORWARD FACING NBR INHIBITOR — FACTORY JOINT <88.4> — FACTORY JOINT <208.4> — FACTORY JOINT <328.5> — AFT FACE OF AFT DOME

<Location From End of Clevis>

180° / 90° / 0° / 270° / 180°



Clevis End



AFT LOOKING FORWARD

- Heavy Liner
- Light (spotty) Liner
- No Liner

Clarification Form(s)? _____ Yes __✓__ No   Clarification Form Page No.(s): __________

REVISION ___

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-8

Igniter Nozzle Insert Throat Diameter Measurements (Data Collection Only)

Motor No.: 360T028	Side: Left (A)	Date: 2-23-93

Assessment Engineer(s)/Inspector(s): C Johnson

Record the Igniter Nozzle Insert Throat Diameter Measurements Below:

Degree Location	Diameter Measurement (inches)
0	6.350
60	6.360
120	6.390

Notes / Comments

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-9
Stiffener Ring Condition

Motor No.: 360T028	Side: Left (A)	Date: 9-1-93

Assessment Engineer(s)/Inspector(s): RED MACKLEY

Ring: Forward Stiffener Ring	Center Stiffener Ring	Aft Stiffener Ring
✓ 90-210 degree section	✓ 90-210 degree section	✓ 90-210 degree section
✓ 210-330 degree section	2 210-330 degree section	2 210-330 degree section
✓ 330-0-90 degree section	2 330-0-90 degree section	2 330-0-90 degree section

Stiffener Ring Observations:

	Yes	No	Comment #
A. Heavy Corrosion?		X	1

Notes / Comments

Special Issue 3.1.2.1:

1 No corrosion was noted on the stiffener ring Chemloked regions.

2 5 of 9 stiffener rings were inspected at Clearfield H-7. The remaining had not yet been water blasted. The following rings were inspected:

P/N	1U52502-08	S/N	38	#1
	-04		90	#1
	-08		43	#3
	-08		89	#2
	-07		89	#1

Preliminary PFAR(s)? ____ Yes X No Preliminary PFAR Number(s): N/A

Clarification Form(s)? ____ Yes X No Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-1
Postfire Insulation Common Planning Index (CPI) Log Numbers

Motor No.: 360T028	Side: Right (B)	Date: 21 JULY 1993

Assessment Engineer(s)/Inspector(s): NORM EDDY

Record CPI Log and Postfire Part and Serial Numbers Below:

	P/N	PPC No.	Serial No.	CPI Log No.
A. Igniter Chamber	N/A	N/A	N/A	N/A
B. Igniter Adapter	1U77457-01	903	10	4CIBH

Notes / Comments

Clarification Form(s)? ______ Yes ______ No Clarification Form Page No.(s): ____________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-2

Segment Internal Insulation Condition (After Low Pressure Rinse)

Motor No.: 360T028	Side: Right (B)	Date: 21 JULY 1993

Assessment Engineer(s)/Inspector(s): NORM EDDY

Segment: Forward

Segment Internal Insulation Observations:

N/A

	Yes	No	Comment #
A. Abnormal Erosion?			
B. Gas Paths?			
C. Ply Separations?			
D. Abnormal Blisters?			
E. Abnormal Cuts or Gouges?			
F. Foreign Material Within Insulation?			
G. Non-Uniformities in the Eleven Point Burn-out Pattern? (Forward Segment Only)			

Notes / Comments

RH SEGMENTS WASHED OUT DUE TO REDUCED POSTFLIGHT INSPECTION PLAN.

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-2
Segment Internal Insulation Condition (After Low Pressure Rinse)

Motor No.: 360T028	Side: Right (B)	Date: 21 JULY 1993
Assessment Engineer(s)/Inspector(s): NORM EDDY		
Segment: Forward Center		

Segment Internal Insulation Observations:

N/A

	Yes	No	Comment #
A. Abnormal Erosion?			
B. Gas Paths?			
C. Ply Separations?			
D. Abnormal Blisters?			
E. Abnormal Cuts or Gouges?			
F. Foreign Material Within Insulation?			
G. Liner Completely Missing? (Center Segments Only)			

Notes / Comments

RH SEGMENTS WASHED OUT DUE TO REDUCED POSTFLIGHT INSPECTION PLAN.

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-2
Segment Internal Insulation Condition (After Low Pressure Rinse)

Motor No.: 360T028	Side: Right (B)	Date: 21 JULY 1993
Assessment Engineer(s)/Inspector(s): NORM EDDY		
Segment: Aft Center		

Segment Internal Insulation Observations: N/A

	Yes	No	Comment #
A. Abnormal Erosion?			
B. Gas Paths?			
C. Ply Separations?			
D. Abnormal Blisters?			
E. Abnormal Cuts or Gouges?			
F. Foreign Material Within Insulation?			
G. Liner Completely Missing? (Center Segments Only)			

Notes / Comments

RH SEGMENTS WASHED OUT DUE TO REDUCED POSTFLIGHT INSPECTION PLAN.

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-2
Segment Internal Insulation Condition (After Low Pressure Rinse)

Motor No.: 360T028	Side: Right (B)	Date:

Assessment Engineer(s)/Inspector(s):

Segment: Aft

Segment Internal Insulation Observations:	Yes	No	Comment #
A. Abnormal Erosion?			
B. Gas Paths?			
C. Ply Separations?			
D. Abnormal Blisters?			
E. Abnormal Cuts or Gouges?			
F. Foreign Material Within Insulation?			
G. NBR Under the CF/EPDM Exposed in the Aft Dome?			

N/A

Notes / Comments RH SEGMENTS WASHED OUT DUE TO REDUCED POSTFLIGHT INSPECTION PLAN.

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

REVISION ____

POSTFLIGHT OBSERVATION RECORD (PFOR) A-8

Igniter Nozzle Insert Throat Diameter Measurements (Data Collection Only)

Motor No.: 360T028	Side: Right (B)	Date: 2-23-93

Assessment Engineer(s)/Inspector(s): C. Johnson

Record the Igniter Nozzle Insert Throat Diameter Measurements Below:

Degree Location	Diameter Measurement (inches)
0	6.311
60	6.318
120	6.305

Notes / Comments

Clarification Form(s)? _____ Yes __✓__ No   Clarification Form Page No.(s): __________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-9
Stiffener Ring Condition

Motor No.: 360T028	Side: Right (B)	Date: 9-1-93

Assessment Engineer(s)/Inspector(s): RED MACKLEY

Ring: Forward Stiffener Ring	Center Stiffener Ring	Aft Stiffener Ring
✓ 90-210 degree section	✓ 90-210 degree section	✓ 90-210 degree section
✓ 210-330 degree section	2 210-330 degree section	2 210-330 degree section
2 330-0-90 degree section	✓ 330-0-90 degree section	✓ 330-0-90 degree section

Stiffener Ring Observations:	Yes	No	Comment #
A. Heavy Corrosion?		X	1

Notes / Comments

Special Issue 3.1.2.1:

1 No corrosion was noted on the stiffener ring Chemloked regions.

2 6 of 9 stiffener rings were inspected at Clearfield H-7. The remaining had not yet been water blasted. The following rings were inspected:

P/N	1U52502 -08	S/N	94	#3
	-08		95	#1
	-04		101	#1
	-08		97	#2
	-07		92	#3
	-07		95	#2

Preliminary PFAR(s)? ____ Yes X No   Preliminary PFAR Number(s): N/A

Clarification Form(s)? ____ Yes X No   Clarification Form Page No.(s): ____

REVISION ____

TWR-64216

Solid Rocket Motor
Thiokol Corporation

Appendix B
Case, Seals, and Joints PFORs

Final Postflight Hardware Evaluation Report
RSRM-28 (STS-53)

November 1993

Prepared for:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER
MARSHALL SPACE FLIGHT CENTER, ALABAMA 35812

Contract No.	NAS8-38100
DR No.	4-23
WBS No.	4C601-04-01
ECS No.	SS4771

Thiokol CORPORATION
SPACE OPERATIONS

P.O. Box 707, Brigham City, Utah 84302-0707 (801) 863-3511

CASE, SEALS, AND JOINTS REQUIRED PFOR LIST

PFOR #	Title	Side	Joint or Location	Final Report Page Number
B-2	S&A Device (Barrier-Booster and Environmental Seal Region) Condition	Left	S&A	B-1
B-7	S&A Rotor Shaft O-ring Condition (Detailed)	Left	S&A	B-2
B-1	Leak Check Plug/SII and Port Condition (At Removal)	Left	S&A 126°	B-3
B-4	Leak Check Plug/SII Condition (Detailed)	Left	S&A 126°	B-4
B-6	Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Left	S&A 126°	B-5
B-1	Leak Check Plug/SII and Port Condition (At Removal)	Left	18° SII	B-6
B-4	Leak Check Plug/SII Condition (Detailed)	Left	18° SII	B-7
B-6	Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Left	18° SII	B-8
B-1	Leak Check Plug/SII and Port Condition (At Removal)	Left	198° SII	B-9
B-4	Leak Check Plug/SII Condition (Detailed)	Left	198° SII	B-10
B-6	Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Left	198° SII	B-11

(Note: Clarification forms will be inserted after the required PFOR in the Final Report. The clarification form page number will be the same as the required PFOR Final Report page number appended by a sequential alphabetic extension.)

CASE, SEALS, AND JOINTS REQUIRED LIST (Cont.)

PFOR #	Title	Side	Joint or Location	Final Report Page Number
B-3	Internal Nozzle Joint Condition	Left	Nozzle Joint #2	B-12
B-5	Large Diameter (Joint) O-ring Condition (Detailed)	Left	Nozzle Joint #2	B-13
B-1	Leak Check Plug/SII and Port Condition (At Removal)	Left	Nozzle Joint #2	B-14
B-4	Leak Check Plug/SII Condition (Detailed)	Left	Nozzle Joint #2	B-15
B-6	Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Left	Nozzle Joint #2	B-16
B-3	Internal Nozzle Joint Condition	Left	Nozzle Joint #3	B-17
B-5	Large Diameter (Joint) O-ring Condition (Detailed)	Left	Nozzle Joint #3	B-18
B-1	Leak Check Plug/SII and Port Condition (At Removal)	Left	Nozzle Joint #3	B-19
B-4	Leak Check Plug/SII Condition (Detailed)	Left	Nozzle Joint #3	B-20
B-6	Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Left	Nozzle Joint #3	B-21
B-3	Internal Nozzle Joint Condition	Left	Nozzle Joint #4	B-22
B-5	Large Diameter (Joint) O-ring Condition (Detailed)	Left	Nozzle Joint #4	B-23
B-1	Leak Check Plug/SII and Port Condition (At Removal)	Left	Nozzle Joint #4	B-24
B-4	Leak Check Plug/SII Condition (Detailed)	Left	Nozzle Joint #4	B-25
B-6	Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Left	Nozzle Joint #4	B-26

(Note: Clarification forms will be inserted after the required PFOR in the Final Report. The clarification form page number will be the same as the required PFOR Final Report page number appended by a sequential alphabetic extension.)

CASE, SEALS, AND JOINTS REQUIRED LIST (Cont.)

PFOR #	Title	Side	Joint or Location	Final Report Page Number
B-3	Internal Nozzle Joint Condition	Left	Nozzle Joint #5	B-27
B-5	Large Diameter (Joint) O-ring Condition (Detailed)	Left	Nozzle Joint #5	B-28
B-1	Leak Check Plug/SII and Port Condition (At Removal)	Left	Nozzle Joint #5	B-29
B-4	Leak Check Plug/SII Condition (Detailed)	Left	Nozzle Joint #5	B-30
B-6	Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Left	Nozzle Joint #5	B-31
B-8	Packing With Retainer Condition (Detailed)	Left	Nozzle Fixed Housing	B-32
B-9	Case Factory Joint Condition	Left	Forward Dome	B-33
B-9	Case Factory Joint Condition	Left	Forward	B-34
B-9	Case Factory Joint Condition	Left	Forward Center	B-35
B-9	Case Factory Joint Condition	Left	Aft Center	B-36
B-9	Case Factory Joint Condition	Left	ET Attach/ Stiffener	B-37
B-9	Case Factory Joint Condition	Left	Stiffener/ Stiffener	B-38
B-9	Case Factory Joint Condition	Left	Aft Dome	B-39
B-10	Case Y-Joint Condition	Left	Forward Dome	B-40
B-10	Case Y-Joint Condition	Left	Aft Dome	B-41

(Note: Clarification forms will be inserted after the required PFOR in the Final Report. The clarification form page number will be the same as the required PFOR Final Report page number appended by a sequential alphabetic extension.)

CASE, SEALS, AND JOINTS REQUIRED LIST (Cont.)

PFOR #	Title	Side	Joint or Location	Final Report Page Number
B-2	S&A Device (Barrier-Booster and Environmental Seal Region) Condition	Right	S&A	B-42
B-7	S&A Rotor Shaft O-ring Condition (Detailed)	Right	S&A	B-43
B-1	Leak Check Plug/SII and Port Condition (At Removal)	Right	S&A 126°	B-44
B-4	Leak Check Plug/SII Condition (Detailed)	Right	S&A 126°	B-45
B-6	Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Right	S&A 126°	B-46
B-1	Leak Check Plug/SII and Port Condition (At Removal)	Right	18° SII	B-47
B-4	Leak Check Plug/SII Condition (Detailed)	Right	18° SII	B-48
B-6	Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Right	18° SII	B-49
B-1	Leak Check Plug/SII and Port Condition (At Removal)	Right	198° SII	B-50
B-4	Leak Check Plug/SII Condition (Detailed)	Right	198° SII	B-51
B-6	Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Right	198° SII	B-52

(Note: Clarification forms will be inserted after the required PFOR in the Final Report. The clarification form page number will be the same as the required PFOR Final Report page number appended by a sequential alphabetic extension.)

CASE, SEALS, AND JOINTS REQUIRED LIST (Cont.)

PFOR #	Title	Side	Joint or Location	Final Report Page Number
B-3	Internal Nozzle Joint Condition	Right	Nozzle Joint #2	B-53
B-5	Large Diameter (Joint) O-ring Condition (Detailed)	Right	Nozzle Joint #2	B-54
B-1	Leak Check Plug/SII and Port Condition (At Removal)	Right	Nozzle Joint #2	B-55
B-4	Leak Check Plug/SII Condition (Detailed)	Right	Nozzle Joint #2	B-56
B-6	Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Right	Nozzle Joint #2	B-57
B-3	Internal Nozzle Joint Condition	Right	Nozzle Joint #3	B-58
B-5	Large Diameter (Joint) O-ring Condition (Detailed)	Right	Nozzle Joint #3	B-59
B-1	Leak Check Plug/SII and Port Condition (At Removal)	Right	Nozzle Joint #3	B-60
B-4	Leak Check Plug/SII Condition (Detailed)	Right	Nozzle Joint #3	B-61
B-6	Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Right	Nozzle Joint #3	B-62
B-3	Internal Nozzle Joint Condition	Right	Nozzle Joint #4	B-63
B-5	Large Diameter (Joint) O-ring Condition (Detailed)	Right	Nozzle Joint #4	B-64
B-1	Leak Check Plug/SII and Port Condition (At Removal)	Right	Nozzle Joint #4	B-65
B-4	Leak Check Plug/SII Condition (Detailed)	Right	Nozzle Joint #4	B-66
B-6	Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Right	Nozzle Joint #4	B-67

(Note: Clarification forms will be inserted after the required PFOR in the Final Report. The clarification form page number will be the same as the required PFOR Final Report page number appended by a sequential alphabetic extension.)

CASE, SEALS, AND JOINTS REQUIRED LIST (Cont.)

PFOR #	Title	Side	Joint or Location	Final Report Page Number
B-3	Internal Nozzle Joint Condition	Right	Nozzle Joint #5	B-68
B-5	Large Diameter (Joint) O-ring Condition (Detailed)	Right	Nozzle Joint #5	B-69
B-1	Leak Check Plug/SII and Port Condition (At Removal)	Right	Nozzle Joint #5	B-70
B-4	Leak Check Plug/SII Condition (Detailed)	Right	Nozzle Joint #5	B-71
B-6	Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Right	Nozzle Joint #5	B-72
B-8	Packing With Retainer Condition (Detailed)	Right	Nozzle Fixed Housing	B-73
B-9	Case Factory Joint Condition	Right	Forward Dome	B-74
B-9	Case Factory Joint Condition	Right	Forward	B-75
B-9	Case Factory Joint Condition	Right	Forward Center	B-76
B-9	Case Factory Joint Condition	Right	Aft Center	B-77
B-9	Case Factory Joint Condition	Right	ET Attach/ Stiffener	B-78
B-9	Case Factory Joint Condition	Right	Stiffener/ Stiffener	B-79
B-9	Case Factory Joint Condition	Right	Aft Dome	B-80
B-10	Case Y-Joint Condition	Right	Forward Dome	B-81
B-10	Case Y-Joint Condition	Right	Aft Dome	B-82

(Note: Clarification forms will be inserted after the required PFOR in the Final Report. The clarification form page number will be the same as the required PFOR Final Report page number appended by a sequential alphabetic extension.)

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-2
S&A Device (Barrier-Booster and Environmental Seal Regions) Condition

Motor No.: 360T028	Side: Left (A)	Date: 21 DEC 92

Assessment Engineer(s)/Inspector(s): G. Hyer, D. Garecht, M. Lynn, D. Bullard, C. Taylor, J. Richardson

Barrier-Booster Bore and Rotor Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring (In Groove)?		✓	
B. Soot To or Past O-rings?		✓	
C. Heat Affected Metal?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Metal Damage?		✓	
F. Excessive or No Grease?		✓	
G. Corrosion?		✓	
H. Foreign Material?		✓	
I. Teflon Retainer Damage?		✓	
Environmental Seal Region Observations:			
J. Environmental O-ring Assembly Damage (Visible Without Magnification)?		✓	
K. Foreign Material?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes __✓__ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes __✓__ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-7
S&A Rotor Shaft O-ring Condition (Detailed)

Motor No.: 360T028	Side: Left (A)	Date: 21 DEC 92

Assessment Engineer(s)/Inspector(s): G. Hyer, D. Garecht, M. Lyon, D. Bullard, C. Taylor, J. B

Location: S&A Device Barrier-Booster Rotor Shaft

	Yes	No	Comment #
Forward Primary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	
Aft Primary O-ring Observations:			
C. Heat Affected or Eroded O-ring?		✓	
D. O-ring Defects/Damage?		✓	
Forward Secondary O-ring Observations:			
E. Heat Affected or Eroded O-ring?		✓	
F. O-ring Defects/Damage?		✓	
Aft Secondary O-ring Observations:			
G. Heat Affected or Eroded O-ring?		✓	
H. O-ring Defects/Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/Sll and Port Condition (At Removal)

Motor No.: 360T028	Side: Left (A)	Date: 21 DEC 92

Assessment Engineer(s)/Inspector(s): G. Hyer, D. Garecht, M. Lyon, D. Bullard, C. Taylor, J. Richardson

Location: 126-Degree Barrier-Booster Bore

Leak Check Plug Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		✓	
B. Soot To or Past O-ring?		✓	
C. Foreign Material?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Heat Affected or Eroded O-ring (In Groove)?		✓	
F. Excessive or No Grease on O-ring?		✓	
G. Excessive Grease on Plug?		✓	
H. Corrosion?		✓	
I. Thread Damage (Visible at Removal)?		✓	

Leak Check Port Observations:	Yes	No	Comment #
J. Sooted Metal Surfaces?		✓	
K. Foreign Material?		✓	
L. Excessive Grease?		✓	
M. Corrosion?		✓	
N. Metal Damage?		✓	
O. Heat Affected Metal?		✓	
P. Obstructed Through Hole?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/Sil Condition (Detailed)

Motor No.: 360T028	Side: Left (A)	Date: 21 DEC 92

Assessment Engineer(s)/Inspector(s): G. Hyer, Diane Garecht, M. Lyon, D. Bullard, C. Taylor, J. Richardson

Location: 126-Degree Barrier-Booster Bore

Leak Check Plug Observations:	Yes	No	Comment #
A. Foreign Material Between the O-ring and Plug?		✓	
B. Heat Affected Metal?		✓	
C. Seal Surface/Thread Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

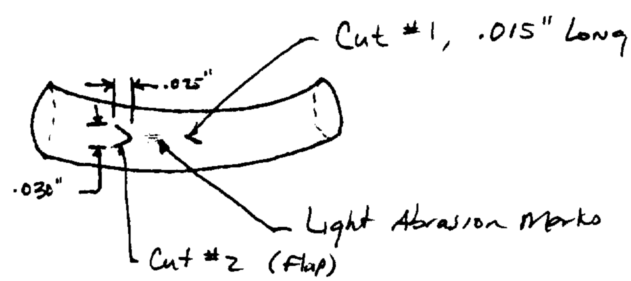
POSTFLIGHT OBSERVATION RECORD (PFOR) B-6
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)

Motor No.: 360T028	Side: Left (A)	Date: 21 DEC 92
Assessment Engineer(s)/Inspector(s): G. Hyer, D. Garecht, M. Lyon, D. Bullard, C Taylor, J. Richards		
Location: 126-Degree Barrier-Booster Bore		

Secondary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?	✓		1

Notes / Comments

#1.) Two cuts observed on O-ring O.D. See sketch below for approximate measurements and clarifications.



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Preliminary PFAR(s)? ✓ Yes ____ No Preliminary PFAR Number(s): 53C-09

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/SII and Port Condition (At Removal)

Motor No.: 360T028	Side: Left (A)	Date: 21 DEC 92

Assessment Engineer(s)/Inspector(s): G. Hyer, D. Garecht, M. Lyon, D. Bullard, C. Taylor, J. Richardson

Location: 18-Degree SII

SII Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		✓	
B. Soot To or Past O-ring?		✓	
C. Foreign Material?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Heat Affected or Eroded O-ring (In Groove)?		✓	
F. Excessive or No Grease on O-ring?		✓	
G. Excessive Grease on SII?		✓	
H. Corrosion?		✓	
I. Thread Damage (Visible at Removal)?		✓	
SII Port Observations:			
J. Sooted Metal Surfaces?		✓	
K. Foreign Material?		✓	
L. Excessive Grease?		✓	
M. Corrosion?		✓	
N. Metal Damage?	✓		1
O. Heat Affected Metal?		✓	
P. Obstructed Leak Check Through Hole?		✓	

Notes / Comments

1.) Typical galling on Land between Primary and Secondary Seal Surface. galling is due to Sealing Washer weld

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/SII Condition (Detailed)

Motor No.: 360T028	Side: Left (A)	Date: 21 Dec 1992

Assessment Engineer(s)/Inspector(s): G. Hyer, D. Garecht, M. Lyon, D. Bullard, C. Taylor, J. Richardson

Location: 18-Degree SII

SII Observations:	Yes	No	Comment #
A. Foreign Material Between the O-ring and SII?		✓	
B. Heat Affected Metal?		✓	
C. Seal Surface/Thread Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ____________

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ____________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)

Motor No.: 360T028	**Side:** Left (A)	**Date:** 21 DEC 92
Assessment Engineer(s)/Inspector(s): G. Hyer, D. Garecht, M. Lyon, D. Bullard, C. Taylor, J. Richards		
Location: 18-Degree SII		

	Yes	No	Comment #
<u>**Primary O-ring Observations:**</u>			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	
<u>**Secondary O-ring Observations:**</u>			
C. Heat Affected or Eroded O-ring?		✓	
D. O-ring Defects/Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ **Yes** ✓ **No** **Preliminary PFAR Number(s):** ______

Clarification Form(s)? ______ **Yes** ✓ **No** **Clarification Form Page No.(s):** ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1

Leak Check Plug/SII and Port Condition (At Removal)

Motor No.: 360T028	Side: Left (A)	Date: 21 DEC 92

Assessment Engineer(s)/Inspector(s): G. Hyer, D. barecht, M. Lyon, D. Bullard, C. Taylor J. Richardson

Location: 198-Degree SII

SII Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		✓	
B. Soot To or Past O-ring?		✓	
C. Foreign Material?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Heat Affected or Eroded O-ring (In Groove)?		✓	
F. Excessive or No Grease on O-ring?		✓	
G. Excessive Grease on SII?		✓	
H. Corrosion?		✓	
I. Thread Damage (Visible at Removal)?		✓	
SII Port Observations:			
J. Sooted Metal Surfaces?		✓	
K. Foreign Material?		✓	
L. Excessive Grease?		✓	
M. Corrosion?		✓	
N. Metal Damage?	✓		1
O. Heat Affected Metal?		✓	
P. Obstructed Leak Check Through Hole?		✓	

Notes / Comments

1.) typical galling observed on the land between the primary and Secondary Sealing Surface, galling is due to Washer weld

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

REVISION ___

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/SII Condition (Detailed)

Motor No.: 360T028	Side: Left (A)	Date: 21 DEC 92

Assessment Engineer(s)/Inspector(s): L. Hyer, D. Barecht, M. Lyon, D. Bullard, C. Taylor, J. Richardson

Location: 198-Degree SII

SII Observations:	Yes	No	Comment #
A. Foreign Material Between the O-ring and SII?		✓	
B. Heat Affected Metal?		✓	
C. Seal Surface/Thread Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)

Motor No.: 360T028	Side: Left (A)	Date: 21 DEC 92
Assessment Engineer(s)/Inspector(s): B. Hyer, D. Garecht, M. Lyon, D. Bullard, C. Taylor, J. Richards		
Location: 198-Degree SII		

Primary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	
Secondary O-ring Observations:			
C. Heat Affected or Eroded O-ring?		✓	
D. O-ring Defects/Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-3
Internal Nozzle Joint Condition

Motor No.: 360T028	Side: Left (A)	Date: 12/15/92

Assessment Engineer(s)/Inspector(s): D. Garecht, M. Nolan

Joint: Nose Inlet-to-Flex Bearing-to-Cowl (Joint #2)

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Soot To or Past O-rings?	√		1
B. Heat Affected Metal?		√	
C. Foreign Material?		√	
D. RTV in Contact With or Past the Primary O-ring?		√	
E. O-ring Damage (In Groove)?		√	
F. Heat Affected or Eroded O-rings (In Groove)?		√	
G. Excessive or No Grease?		√	
H. Corrosion?	√		2
I. Metal Damage?	√		3

Notes / Comments

1 Soot to bolt hole circle 0°-360° and to primary intermittent full circumference.

2 Intermittent light corrosion full circumference

3 One burnish mark (caused by disassembly) was noted on the nose inlet housing secondary seal surface.

Preliminary PFAR(s)? ____ Yes √ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes √ No Clarification Form Page No.(s): ____

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-5
Large Diameter (Joint) O-ring Condition (Detailed)

Motor No.: 360T028	Side: Left (A)	Date: 12/15/92

Assessment Engineer(s)/Inspector(s): D. Garecht, M. Nolan

Joint: Nose Inlet-to-Flex Bearing-to-Cowl (Joint #2)

	Yes	No	Comment #
Primary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Damage/Defects?		✓	
Secondary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Damage/Defects?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/Sil and Port Condition (At Removal)

Motor No.: 360T028	Side: Left (A)	Date: 12/15/92

Assessment Engineer(s)/Inspector(s): D. Garecht, M. Nolan

Location: Nose Inlet-to-Flex Bearing-to-Cowl (Joint #2)

Leak Check Plug Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		✓	
B. Soot To or Past O-ring?		✓	
C. Foreign Material?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Heat Affected or Eroded O-ring (In Groove)?		✓	
F. Excessive or No Grease on O-ring?		✓	
G. Excessive Grease on Plug?		✓	
H. Corrosion?		✓	
I. Thread Damage (Visible at Removal)?		✓	
Leak Check Port Observations:			
J. Sooted Metal Surfaces?		✓	
K. Foreign Material?		✓	
L. Excessive Grease?		✓	
M. Corrosion?		✓	
N. Metal Damage?		✓	
O. Heat Affected Metal?		✓	
P. Obstructed Through Hole?		✓	

Notes / Comments

Breakaway .32 in.lb
Running .07 in.lb

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/Sil Condition (Detailed)

Motor No.: 360T028	Side: Left (A)	Date: 12/15/92
Assessment Engineer(s)/Inspector(s): D. Garecht, M. Nolan		
Location: Nose Inlet-to-Flex Bearing-to-Cowl (Joint #2)		

Leak Check Plug Observations:	Yes	No	Comment #
A. Foreign Material Between the O-ring and Plug?		✓	
B. Heat Affected Metal?		✓	
C. Seal Surface/Thread Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ____________

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ____________

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)

Motor No.: 360T028	Side: Left (A)	Date: 12/15/92

Assessment Engineer(s)/Inspector(s): D. Gareckt, M. Nolan

Location: Nose Inlet-to-Flex Bearing-to-Cowl (Joint #2)

Secondary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

REVISION ____

POSTFLIGHT OBSERVATION RECORD (PFOR) B-3
Internal Nozzle Joint Condition

Motor No.: 360T028	Side: Left (A)	Date: 12-16-92
Assessment Engineer(s)/Inspector(s): Diane Garecht, Mike Nolan		
Joint: Nose Inlet-to-Throat (Joint #3)		

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Soot To or Past O-rings?		✓	
B. Heat Affected Metal?		✓	
C. Foreign Material?		✓	
D. RTV in Contact With or Past the Primary O-ring?		✓	
E. O-ring Damage (In Groove)?		✓	
F. Heat Affected or Eroded O-rings (In Groove)?		✓	
G. Excessive or No Grease?		✓	
H. Corrosion?	✓		1
I. Metal Damage?		✓	

Notes / Comments

1 Light/medium corrosion, intermittent full circumference

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ____________

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ____________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-5
Large Diameter (Joint) O-ring Condition (Detailed)

Motor No.: 360T028	Side: Left (A)	Date: 12/16/92
Assessment Engineer(s)/Inspector(s): D. Garecht, M. Nolan		
Joint: Nose Inlet-to-Throat (Joint #3)		

	Yes	No	Comment #
<u>Primary O-ring Observations:</u>			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Damage/Defects?		✓	
<u>Secondary O-ring Observations:</u>			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Damage/Defects?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/Sil and Port Condition (At Removal)

Motor No.: 360T028	Side: Left (A)	Date: 12-16-92
Assessment Engineer(s)/Inspector(s): Diane Aarecht		
Location: Nose Inlet-to-Throat (Joint #3)		

Leak Check Plug Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		✓	
B. Soot To or Past O-ring?		✓	
C. Foreign Material?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Heat Affected or Eroded O-ring (In Groove)?		✓	
F. Excessive or No Grease on O-ring?		✓	
G. Excessive Grease on Plug?		✓	
H. Corrosion?		✓	
I. Thread Damage (Visible at Removal)?		✓	

Leak Check Port Observations:	Yes	No	Comment #
J. Sooted Metal Surfaces?		✓	
K. Foreign Material?		✓	
L. Excessive Grease?		✓	
M. Corrosion?		✓	
N. Metal Damage?		✓	
O. Heat Affected Metal?		✓	
P. Obstructed Through Hole?		✓	

Notes / Comments

Breakaway: 40 in. lb
Running: 10 in lb ✓

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/SII Condition (Detailed)

Motor No.: 360T028	Side: Left (A)	Date: 12-16-92

Assessment Engineer(s)/Inspector(s): Diane Garecht, Mike Nolan

Location: Nose Inlet-to-Throat (Joint #3)

Leak Check Plug Observations:	Yes	No	Comment #
A. Foreign Material Between the O-ring and Plug?		✓	
B. Heat Affected Metal?		✓	
C. Seal Surface/Thread Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)

Motor No.: 360T028	Side: Left (A)	Date: 12-16-92

Assessment Engineer(s)/Inspector(s): Diane Barecht, Mike Nolan

Location: Nose Inlet-to-Throat (Joint #3)

Secondary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes __✓__ No Preliminary PFAR Number(s): ____________

Clarification Form(s)? ______ Yes __✓__ No Clarification Form Page No.(s): ____________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-3
Internal Nozzle Joint Condition

Motor No.: 360T028	**Side:** Left (A)	**Date:** 12-15-97
Assessment Engineer(s)/Inspector(s): Rocky Ash, Gordon Hyer, Marv Lyon		
Joint: Throat-to-Forward Exit Cone (Joint #4)		

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Soot To or Past O-rings?		✓	
B. Heat Affected Metal?		✓	
C. Foreign Material?		✓	
D. RTV in Contact With or Past the Primary O-ring?	✓		1
E. O-ring Damage (In Groove)?		✓	
F. Heat Affected or Eroded O-rings (In Groove)?		✓	
G. Excessive or No Grease?		✓	
H. Corrosion?	✓		2
I. Metal Damage?		✓	

Notes / Comments

1) RTV reached the primary O-ring between 37.5° - 165° and 247.5 - 347.5°

2) Light-to-medium corrosion observed between the primary and secondary O-rings full circumference (Throat). Non seal surface Light-to-medium corrosion observed on the forward exit cone between the phenolic and secondary O-ring footprint full circumference.

Preliminary PFAR(s)? ____ Yes ✓ No **Preliminary PFAR Number(s):** ____

Clarification Form(s)? ____ Yes ✓ No **Clarification Form Page No.(s):** ____

POSTFLIGHT OBSERVATION RECORD (PFOR) B-5
Large Diameter (Joint) O-ring Condition (Detailed)

Motor No.: 360T028 | Side: Left (A) | Date: 12-15-92

Assessment Engineer(s)/Inspector(s): Rocky Ash, Gordon Hyer, Marv Lyon

Joint: Throat-to-Forward Exit Cone (Joint #4)

Primary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Damage/Defects?		✓	
Secondary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Damage/Defects?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/Sll and Port Condition (At Removal)

Motor No.: 360T028	Side: Left (A)	Date: 12-15-92

Assessment Engineer(s)/Inspector(s): Rocky Ash, Gordon Hyer, Mary Lyon

Location: Throat-to-Forward Exit Cone (Joint #4)

Leak Check Plug Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		✓	
B. Soot To or Past O-ring?		✓	
C. Foreign Material?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Heat Affected or Eroded O-ring (In Groove)?		✓	
F. Excessive or No Grease on O-ring?		✓	
G. Excessive Grease on Plug?		✓	
H. Corrosion?	✓		1
I. Thread Damage (Visible at Removal)?		✓	

Leak Check Port Observations:	Yes	No	Comment #
J. Sooted Metal Surfaces?		✓	
K. Foreign Material?		✓	
L. Excessive Grease?		✓	
M. Corrosion?	✓		2
N. Metal Damage?		✓	
O. Heat Affected Metal?		✓	
P. Obstructed Through Hole?		✓	

Notes / Comments

1) Light corrosion observed on the tip of the plug.
2) Medium corrosion observed in the bottom of the port. Two small areas of light corrosion observed on the spotface.

Breakaway Torque 36 in-lbs.
Running Torque 10 in-lbs.

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/SII Condition (Detailed)

Motor No.: 360T028	Side: Left (A)	Date: 12-15-92
Assessment Engineer(s)/Inspector(s): Rocky Ash, Gordon Hyer, Marv Lyon		
Location: Throat-to-Forward Exit Cone (Joint #4)		

Leak Check Plug Observations:

	Yes	No	Comment #
A. Foreign Material Between the O-ring and Plug?		✓	
B. Heat Affected Metal?		✓	
C. Seal Surface/Thread Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)

Motor No.: 360T028	Side: Left (A)	Date: 12-15-92

Assessment Engineer(s)/Inspector(s): Perky Ash, Golden Hyer, Marv Lyon

Location: Throat-to-Forward Exit Cone (Joint #4)

Secondary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

POSTFLIGHT OBSERVATION RECORD (PFOR) B-3
Internal Nozzle Joint Condition

Motor No.: 360T028	Side: Left (A)	Date: 12-15-92
Assessment Engineer(s)/Inspector(s): Rocky Ash, Gordon Hyer, Mary Lyon		
Joint: Aft End Ring-to-Fixed Housing (Joint #5)		

Internal Nozzle Joint Observations:

	Yes	No	Comment #
A. Soot To or Past O-rings?		✓	
B. Heat Affected Metal?		✓	
C. Foreign Material?		✓	
D. RTV in Contact With or Past the Primary O-ring?	✓		1
E. O-ring Damage (In Groove)?		✓	
F. Heat Affected or Eroded O-rings (In Groove)?		✓	
G. Excessive or No Grease?		✓	
H. Corrosion?	✓		2
I. Metal Damage?		✓	3

Notes / Comments

Special Issue 3.2.3.1: No anomalous conditions were observed. Grease application was nominal.

1) RTV reached the primary O-ring between 205° - 260° and 30° - 85°.

2) Medium corrosion observed on aft end flange, ID ~~inner lip~~ intermittent full circumference. ~~Light corrosion observed on the fxd hsg.~~

3) Metal shavings were observed on several of the bolts. Metal shavings were found towards the end of the bolt near the nylok patch.

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ________

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-5
Large Diameter (Joint) O-ring Condition (Detailed)

Motor No.: 360T028	**Side:** Left (A)	**Date:** 12-15-92

Assessment Engineer(s)/Inspector(s): Rocky Ash, Gordon Hyer, Marv Lyon

Joint: Aft End Ring-to-Fixed Housing (Joint #5)

	Yes	No	Comment #
Primary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Damage/Defects?		✓	
Secondary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Damage/Defects?		✓	

Notes / Comments

Special Issue 3.2.3.1: No anomalous conditions were observed. Grease application was nominal.

Preliminary PFAR(s)? ______ Yes ✓ No **Preliminary PFAR Number(s):** ______

Clarification Form(s)? ______ Yes ✓ No **Clarification Form Page No.(s):** ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/SII and Port Condition (At Removal)

Motor No.: 360T028	Side: Left (A)	Date: 12-15-92

Assessment Engineer(s)/Inspector(s): Rocky Ash, Gordon Hyer, Marv Lyon

Location: Aft End Ring-to-Fixed Housing (Joint #5)

Leak Check Plug Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		✓	
B. Soot To or Past O-ring?		✓	
C. Foreign Material?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Heat Affected or Eroded O-ring (In Groove)?		✓	
F. Excessive or No Grease on O-ring?		✓	
G. Excessive Grease on Plug?		✓	
H. Corrosion?		✓	
I. Thread Damage (Visible at Removal)?		✓	

Leak Check Port Observations:	Yes	No	Comment #
J. Sooted Metal Surfaces?		✓	
K. Foreign Material?		✓	
L. Excessive Grease?		✓	
M. Corrosion?		✓	
N. Metal Damage?		✓	
O. Heat Affected Metal?		✓	
P. Obstructed Through Hole?		✓	

Notes / Comments

Breakaway Torque - 40 in-lbs
Running Torque - 15 in-lbs

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/SII Condition (Detailed)

Motor No.: 360T028	Side: Left (A)	Date: 12-15-92

Assessment Engineer(s)/Inspector(s): Rocky Ash, Gordon Hyer, Marv Lyon

Location: Aft End Ring-to-Fixed Housing (Joint #5)

Leak Check Plug Observations:	Yes	No	Comment #
A. Foreign Material Between the O-ring and Plug?		✓	
B. Heat Affected Metal?		✓	
C. Seal Surface/Thread Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)

Motor No.: 360T028	Side: Left (A)	Date: 12-15-92

Assessment Engineer(s)/Inspector(s): Rocky Ash, Gordon Hyer, Marv Lyon

Location: Aft End Ring-to-Fixed Housing (Joint #5)

Secondary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

POSTFLIGHT OBSERVATION RECORD (PFOR) B-8
Packing With Retainer Condition (Detailed)

Motor No.: 360T028	Side: Left (A)	Date: 12-15-92
Assessment Engineer(s)/Inspector(s): Rocky Ash, Gordon Hyer, Marv Lyon		
Joint: Aft End Ring-to-Fixed Housing (Joint #5)		

Packing With Retainer Observations:

	Yes	No	Comment #
A. Heat Affected or Eroded Seal or Retainer?		✓	
B. Seal or Retainer Damage/Defects?	✓		
C. Corrosion?		✓	

Notes / Comments

1) All 72 packings with retainers had typical disassembly damage to the rubber seal.

Preliminary PFAR(s)? ______ Yes __✓__ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes __✓__ No   Clarification Form Page No.(s): ______

POSTFLIGHT OBSERVATION RECORD (PFOR) B-9
Case Factory Joint Condition

Motor No.: 360T028	Side: Left (A)	Date: 04-05-93
Assessment Engineer(s)/Inspector(s): GARY W. ASPER (QA.)		
Factory Joint: Forward Dome		

<u>Case Factory Joint Observations:</u>

	Yes	No	Comment #
A. Heat Affected or Eroded Joint O-ring?		✓	
B. Heavy Corrosion in Joint?		✓	
C. Heavy Corrosion in Leak Check Port?		✓	

Note: Heavy corrosion is defined as corrosion that causes pitting. It may be necessary to remove corrosion to determine if pitting has occurred; however, care should be taken not to damage the hardware. A cloth dampened with solvent or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ____________

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ____________

Thiokol CORPORATION
SPACE OPERATIONS

To Bryan Nielson

POSTFLIGHT OBSERVATION RECORD (PFOR) B-9
Case Factory Joint Condition

Motor No.: 360T028	Side: Left (A)	Date: 04-05-93

Assessment Engineer(s)/Inspector(s): H. ZAREMBA

Factory Joint: Forward

Case Factory Joint Observations:

	Yes	No	Comment #
A. Heat Affected or Eroded Joint O-ring?		X	
B. Heavy Corrosion in Joint?		X	#1
C. Heavy Corrosion in Leak Check Port?		X	

Note: Heavy corrosion is defined as corrosion that causes pitting. It may be necessary to remove corrosion to determine if pitting has occurred; however, care should be taken not to damage the hardware. A cloth dampened with solvent or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

#1. Note: Fretting exists on tang seal of case to case factory-joint @ approximately 110.5°.
B/M S/N 0000079

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

POSTFLIGHT OBSERVATION RECORD (PFOR) B-9
Case Factory Joint Condition

Motor No.: 360T028	Side: Left (A)	Date: 6-28-93
Assessment Engineer(s)/Inspector(s): R. BYRNS		
Factory Joint: Forward Center		

Case Factory Joint Observations:

	Yes	No	Comment #
A. Heat Affected or Eroded Joint O-ring?		✓	
B. Heavy Corrosion in Joint?		✓	
C. Heavy Corrosion in Leak Check Port?		✓	

Note: Heavy corrosion is defined as corrosion that causes pitting. It may be necessary to remove corrosion to determine if pitting has occurred; however, care should be taken not to damage the hardware. A cloth dampened with solvent or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

None

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-9
Case Factory Joint Condition

Motor No.: 360T028	Side: Left (A)	Date: 07-07-95

Assessment Engineer(s)/Inspector(s): Wade Cardon

Factory Joint: Aft Center

Case Factory Joint Observations:	Yes	No	Comment #
A. Heat Affected or Eroded Joint O-ring?		✓	
B. Heavy Corrosion in Joint?		✓	
C. Heavy Corrosion in Leak Check Port?		✓	

Note: Heavy corrosion is defined as corrosion that causes pitting. It may be necessary to remove corrosion to determine if pitting has occurred; however, care should be taken not to damage the hardware. A cloth dampened with solvent or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments NONE

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): N/A

Clarification Form(s)? _____ Yes ✓ No Clarification Form Page No.(s): N/A

POSTFLIGHT OBSERVATION RECORD (PFOR) B-9
Case Factory Joint Condition

Motor No.: 360T028	Side: Left (A)	Date: 04-02-93
Assessment Engineer(s)/Inspector(s): C. Brown		
Factory Joint: ET Attach/Stiffener		

Case Factory Joint Observations:

	Yes	No	Comment #
A. Heat Affected or Eroded Joint O-ring?		✓	
B. Heavy Corrosion in Joint?		✓	
C. Heavy Corrosion in Leak Check Port?		✓	

Note: Heavy corrosion is defined as corrosion that causes pitting. It may be necessary to remove corrosion to determine if pitting has occurred; however, care should be taken not to damage the hardware. A cloth dampened with solvent or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments NONE

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): N/A

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): N/A

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-9
Case Factory Joint Condition

Motor No.: 360T028	Side: Left (A)	Date: 04-02-93
Assessment Engineer(s)/Inspector(s): C. Brown		
Factory Joint: Stiffener/Stiffener		

<u>Case Factory Joint Observations:</u>

	Yes	No	Comment #
A. Heat Affected or Eroded Joint O-ring?		✓	
B. Heavy Corrosion in Joint?		✓	
C. Heavy Corrosion in Leak Check Port?		✓	

Note: Heavy corrosion is defined as corrosion that causes pitting. It may be necessary to remove corrosion to determine if pitting has occurred; however, care should be taken not to damage the hardware. A cloth dampened with solvent or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments NONE

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): N/A

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): N/A

POSTFLIGHT OBSERVATION RECORD (PFOR) B-9
Case Factory Joint Condition

Motor No.: 360T028	Side: Left (A)	Date: 04-02-93
Assessment Engineer(s)/Inspector(s): C. Brown		
Factory Joint: Aft Dome		

Case Factory Joint Observations:

	Yes	No	Comment #
A. Heat Affected or Eroded Joint O-ring?		✓	
B. Heavy Corrosion in Joint?		✓	
C. Heavy Corrosion in Leak Check Port?		✓	

Note: Heavy corrosion is defined as corrosion that causes pitting. It may be necessary to remove corrosion to determine if pitting has occurred; however, care should be taken not to damage the hardware. A cloth dampened with solvent or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments NONE

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): N/A

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): N/A

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-10
Case Y-Joint Condition

Motor No.: 360T028	Side: Left (A)	Date: 31 Aug 93

Assessment Engineer(s)/Inspector(s): NA

Y-Joint: Forward Dome

Case Y-Joint Observations:	Yes	No	Comment #
A. Corrosion?	NA	NA	1

Notes / Comments

Special Issue 3.2.1.1

1. Assessment was not done.

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

POSTFLIGHT OBSERVATION RECORD (PFOR) B-10
Case Y-Joint Condition

Motor No.: 360T028	Side: Left (A)	Date:
Assessment Engineer(s)/Inspector(s):		
Y-Joint: Aft Dome		

Case Y-Joint Observations:	Yes	No	Comment #
A. Corrosion?	____	____	____

Notes / Comments

Special Issue 3.2.1.1

Preliminary PFAR(s)? ______ Yes ______ No Preliminary PFAR Number(s): ____________

Clarification Form(s)? ______ Yes ______ No Clarification Form Page No.(s): ____________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-2
S&A Device (Barrier-Booster and Environmental Seal Regions) Condition

Motor No.: 360T028	Side: Right (B)	Date: 21 DEC 92

Assessment Engineer(s)/Inspector(s): B. Hyer, D. Garecht, M. Lyon, D. Bullard, C. Taylor, J. [illegible]

Barrier-Booster Bore and Rotor Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring (In Groove)?		✓	
B. Soot To or Past O-rings?		✓	
C. Heat Affected Metal?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Metal Damage?	✓		1
F. Excessive or No Grease?		✓	
G. Corrosion?		✓	
H. Foreign Material?		✓	
I. Teflon Retainer Damage?		✓	
Environmental Seal Region Observations:			
J. Environmental O-ring Assembly Damage (Visible Without Magnification)?		✓	
K. Foreign Material?		✓	

Notes / Comments

1. Minor thread damage (two small dings) exist on first thread of Safing Pin Retainer (Arm Monitor). Small metal shavings present in safing pin retainer cap.

Preliminary PFAR(s)? ✓ Yes ___ No Preliminary PFAR Number(s): 53C-08

Clarification Form(s)? ___ Yes ✓ No Clarification Form Page No.(s): ___

REVISION ___

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-7
S&A Rotor Shaft O-ring Condition (Detailed)

Motor No.: 360T028	Side: Right (B)	Date: 21 DEC 92
Assessment Engineer(s)/Inspector(s): G. Hyer, D. Garecht, M. Lyon, D. Bullard, C. Taylor, J. Ed...		
Location: S&A Device Barrier-Booster Rotor Shaft		

	Yes	No	Comment #
Forward Primary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	
Aft Primary O-ring Observations:			
C. Heat Affected or Eroded O-ring?		✓	
D. O-ring Defects/Damage?		✓	
Forward Secondary O-ring Observations:			
E. Heat Affected or Eroded O-ring?		✓	
F. O-ring Defects/Damage?		✓	
Aft Secondary O-ring Observations:			
G. Heat Affected or Eroded O-ring?		✓	
H. O-ring Defects/Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/SII and Port Condition (At Removal)

Motor No.: 360T028	Side: Right (B)	Date: 21 DEC 92

Assessment Engineer(s)/Inspector(s): G. Hyer, D. Garecht, M. Lyon, D. Bulbed, C. Taylor, J. Richards

Location: 126-Degree Barrier-Booster Bore

Leak Check Plug Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		✓	
B. Soot To or Past O-ring?		✓	
C. Foreign Material?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Heat Affected or Eroded O-ring (In Groove)?		✓	
F. Excessive or No Grease on O-ring?		✓	
G. Excessive Grease on Plug?		✓	
H. Corrosion?		✓	
I. Thread Damage (Visible at Removal)?		✓	
Leak Check Port Observations:			
J. Sooted Metal Surfaces?		✓	
K. Foreign Material?		✓	
L. Excessive Grease?		✓	
M. Corrosion?		✓	
N. Metal Damage?		✓	
O. Heat Affected Metal?		✓	
P. Obstructed Through Hole?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/SII Condition (Detailed)

Motor No.: 360T028	Side: Right (B)	Date: 21 DEC 92

Assessment Engineer(s)/Inspector(s): G. Hyer, D. Garecht, M. Lyon, D. Bullard, C. Taylor, J. Richardson

Location: 126-Degree Barrier-Booster Bore

Leak Check Plug Observations:

	Yes	No	Comment #
A. Foreign Material Between the O-ring and Plug?		✓	
B. Heat Affected Metal?		✓	
C. Seal Surface/Thread Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)

Motor No.: 360T028	Side: Right (B)	Date: 21 Dec 92

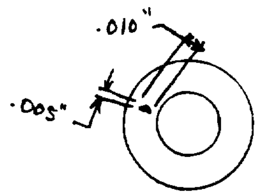
Assessment Engineer(s)/Inspector(s): G. Hyer, D. Garecht, M. Lyon, C. Taylor, Jo Richards

Location: 126-Degree Barrier-Booster Bore

Secondary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?	✓		#1

Notes / Comments

A small cut was observed on the side wall of the o-ring. see sketch below for measurement & clarification.



Preliminary PFAR(s)? ✓ Yes ____ No   Preliminary PFAR Number(s): 53C-10

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/SII and Port Condition (At Removal)

Motor No.: 360T028	Side: Right (B)	Date: 21 Dec 92
Assessment Engineer(s)/Inspector(s): G. Hyer, D. Garecht, M. Lyon, D. Bullard, C. Taylor, J. Richardson		
Location: 18-Degree SII		

SII Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		✓	
B. Soot To or Past O-ring?		✓	
C. Foreign Material?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Heat Affected or Eroded O-ring (In Groove)?		✓	
F. Excessive or No Grease on O-ring?		✓	
G. Excessive Grease on SII?		✓	
H. Corrosion?		✓	
I. Thread Damage (Visible at Removal)?		✓	

SII Port Observations:	Yes	No	Comment #
J. Sooted Metal Surfaces?		✓	
K. Foreign Material?		✓	
L. Excessive Grease?		✓	
M. Corrosion?		✓	
N. Metal Damage?	✓	~~✓~~	#1
O. Heat Affected Metal?		✓	
P. Obstructed Leak Check Through Hole?		✓	

Notes / Comments

1. Typical galling on land between primary & secondary seal surface. galling is due to sealing washer weld.

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/Sll Condition (Detailed)

Motor No.: 360T028	Side: Right (B)	Date: 21 Dec 92

Assessment Engineer(s)/Inspector(s): G. Hyer, D. Bprecht, M. Lyon, J. Richardson, D. Ballard, C. Taylor

Location: 18-Degree Sll

Sll Observations:	Yes	No	Comment #
A. Foreign Material Between the O-ring and Sll?		✓	
B. Heat Affected Metal?		✓	
C. Seal Surface/Thread Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes __✓__ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes __✓__ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)

Motor No.: 360T028	Side: Right (B)	Date: 21 Dec 92

Assessment Engineer(s)/Inspector(s): G. Hyer, D. Garecht, M. Lyon, D. Bullard, C. Taylor, J. Richards

Location: 18-Degree SII

Primary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	
Secondary O-ring Observations:			
C. Heat Affected or Eroded O-ring?		✓	
D. O-ring Defects/Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes __✓__ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ____ Yes __✓__ No Clarification Form Page No.(s): ______

REVISION ___

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/SII and Port Condition (At Removal)

Motor No.: 360T028	Side: Right (B)	Date: 21 Dec 92

Assessment Engineer(s)/Inspector(s): G. Hyer, D. Garecht, M. Lyon, D. Bullard, C. Taylor, J. Richardson

Location: 198-Degree SII

SII Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		✓	
B. Soot To or Past O-ring?		✓	
C. Foreign Material?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Heat Affected or Eroded O-ring (In Groove)?		✓	
F. Excessive or No Grease on O-ring?		✓	
G. Excessive Grease on SII?		✓	
H. Corrosion?		✓	
I. Thread Damage (Visible at Removal)?		✓	
SII Port Observations:			
J. Sooted Metal Surfaces?		✓	
K. Foreign Material?		✓	
L. Excessive Grease?		✓	
M. Corrosion?		✓	
N. Metal Damage?	✓	~~✓~~ mgl	#1
O. Heat Affected Metal?		✓	
P. Obstructed Leak Check Through Hole?		✓	

Notes / Comments

#1. Typical galling on land between primary & secondary seal surface
galling is due to sealing washer weld.

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/SII Condition (Detailed)

Motor No.: 360T028	Side: Right (B)	Date: 21 DEC 92

Assessment Engineer(s)/Inspector(s): G. Hyer, D. Garecht, M. Lyon, D. Bullard, C. Taylor, J. Richards

Location: 198-Degree SII

SII Observations:

	Yes	No	Comment #
A. Foreign Material Between the O-ring and SII?		✓	
B. Heat Affected Metal?		✓	
C. Seal Surface/Thread Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes __✓__ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes __✓__ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)

Motor No.: 360T028	Side: Right (B)	Date: 21 DEC 92

Assessment Engineer(s)/Inspector(s): G. Hyer, D. Garecht, M. Lyon, D. Bullard, C. Taylor, J. Richards

Location: 198-Degree SII

	Yes	No	Comment #
Primary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	
Secondary O-ring Observations:			
C. Heat Affected or Eroded O-ring?		✓	
D. O-ring Defects/Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

POSTFLIGHT OBSERVATION RECORD (PFOR) B-3
Internal Nozzle Joint Condition

Motor No.: 360T028	Side: Right (B)	Date: 12/15/92

Assessment Engineer(s)/Inspector(s): D. Garecht, M. Nolan

Joint: Nose Inlet-to-Flex Bearing-to-Cowl (Joint #2)

Internal Nozzle Joint Observations:

	Yes	No	Comment #
A. Soot To or Past O-rings?	✓		1
B. Heat Affected Metal?		✓	
C. Foreign Material?		✓	
D. RTV in Contact With or Past the Primary O-ring?		✓	
E. O-ring Damage (In Groove)?		✓	
F. Heat Affected or Eroded O-rings (In Groove)?		✓	
G. Excessive or No Grease?		✓	
H. Corrosion?	✓		2
I. Metal Damage?		✓	

Notes / Comments

1 Soot to primary intermittent 90°-185°.
2 Intermittent light-medium corrosion full circumference.

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-5
Large Diameter (Joint) O-ring Condition (Detailed)

Motor No.: 360T028	Side: Right (B)	Date: 12/15/92
Assessment Engineer(s)/Inspector(s): D. Garecht, M. Nolan		
Joint: Nose Inlet-to-Flex Bearing-to-Cowl (Joint #2)		

	Yes	No	Comment #
Primary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Damage/Defects?		✓	
Secondary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Damage/Defects?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/SII and Port Condition (At Removal)

Motor No.: 360T028	Side: Right (B)	Date: 12/15/92

Assessment Engineer(s)/Inspector(s): D. Barecht, M. Nolan

Location: Nose Inlet-to-Flex Bearing-to-Cowl (Joint #2)

Leak Check Plug Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		✓	
B. Soot To or Past O-ring?		✓	
C. Foreign Material?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Heat Affected or Eroded O-ring (In Groove)?		✓	
F. Excessive or No Grease on O-ring?		✓	
G. Excessive Grease on Plug?		✓	
H. Corrosion?		✓	
I. Thread Damage (Visible at Removal)?		✓	
Leak Check Port Observations:			
J. Sooted Metal Surfaces?		✓	
K. Foreign Material?		✓	
L. Excessive Grease?		✓	
M. Corrosion?		✓	
N. Metal Damage?		✓	
O. Heat Affected Metal?		✓	
P. Obstructed Through Hole?		✓	

Notes / Comments

Breakaway: 38 in·lb
Running: 7 in·lb

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/Sil Condition (Detailed)

Motor No.: 360T028	Side: Right (B)	Date: 12/15/92

Assessment Engineer(s)/Inspector(s): D. Garecht, M. Nolan

Location: Nose Inlet-to-Flex Bearing-to-Cowl (Joint #2)

Leak Check Plug Observations:	Yes	No	Comment #
A. Foreign Material Between the O-ring and Plug?		✓	
B. Heat Affected Metal?		✓	
C. Seal Surface/Thread Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)

Motor No.: 360T028	Side: Right (B)	Date: 12/15/92
Assessment Engineer(s)/Inspector(s): Diane Garecht, Mike Nolan		
Location: Nose Inlet-to-Flex Bearing-to-Cowl (Joint #2)		

Secondary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-3
Internal Nozzle Joint Condition

Motor No.: 360T028	Side: Right (B)	Date: 12/10/92

Assessment Engineer(s)/Inspector(s): Diane Garecht, Mike Nolan

Joint: Nose Inlet-to-Throat (Joint #3)

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Soot To or Past O-rings?		✓	
B. Heat Affected Metal?		✓	
C. Foreign Material?		✓	
D. RTV in Contact With or Past the Primary O-ring?		✓	
E. O-ring Damage (In Groove)?		✓	
F. Heat Affected or Eroded O-rings (In Groove)?		✓	
G. Excessive or No Grease?		✓	
H. Corrosion?	✓		1
I. Metal Damage?		✓	

Notes / Comments

1 Light/medium corrosion intermittent full circumference (nose inlet and throat)

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

POSTFLIGHT OBSERVATION RECORD (PFOR) B-5
Large Diameter (Joint) O-ring Condition (Detailed)

Motor No.: 360T028	Side: Right (B)	Date: 12/16/92
Assessment Engineer(s)/Inspector(s): D. Barecht, Mike Nolan		
Joint: Nose Inlet-to-Throat (Joint #3)		

	Yes	No	Comment #
Primary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Damage/Defects?		✓	
Secondary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Damage/Defects?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/Sil and Port Condition (At Removal)

Motor No.: 360T028	Side: Right (B)	Date: 12/16/92

Assessment Engineer(s)/Inspector(s): Diane Garecht, Mike Nolan

Location: Nose Inlet-to-Throat (Joint #3)

Leak Check Plug Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		✓	
B. Soot To or Past O-ring?		✓	
C. Foreign Material?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Heat Affected or Eroded O-ring (In Groove)?		✓	
F. Excessive or No Grease on O-ring?		✓	
G. Excessive Grease on Plug?		✓	
H. Corrosion?		✓	
I. Thread Damage (Visible at Removal)?			

Leak Check Port Observations:	Yes	No	Comment #
J. Sooted Metal Surfaces?		✓	
K. Foreign Material?		✓	
L. Excessive Grease?		✓	
M. Corrosion?		✓	
N. Metal Damage?		✓	
O. Heat Affected Metal?		✓	
P. Obstructed Through Hole?			

Notes / Comments

Breakaway 45 in·lb
Running 26 in·lb

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/Sll Condition (Detailed)

Motor No.: 360T028	Side: Right (B)	Date: 12/16/92
Assessment Engineer(s)/Inspector(s): D. Barecht, Mike Nolan		
Location: Nose Inlet-to-Throat (Joint #3)		

Leak Check Plug Observations:

	Yes	No	Comment #
A. Foreign Material Between the O-ring and Plug?		√	
B. Heat Affected Metal?		√	
C. Seal Surface/Thread Damage?		√	

Notes / Comments

Preliminary PFAR(s)? ______ Yes √ No   Preliminary PFAR Number(s): ____________

Clarification Form(s)? ______ Yes √ No   Clarification Form Page No.(s): ____________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6

Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)

Motor No.: 360T028	Side: Right (B)	Date: 12/16/92

Assessment Engineer(s)/Inspector(s): D. Garecht, M. Nolan

Location: Nose Inlet-to-Throat (Joint #3)

Secondary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes __✓__ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes __✓__ No Clarification Form Page No.(s): ______

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-3
Internal Nozzle Joint Condition

Motor No.: 360T028	Side: Right (B)	Date: 12-15-92

Assessment Engineer(s)/Inspector(s): Ricky Ash, Gordon Hyer, Mary Lyon

Joint: Throat-to-Forward Exit Cone (Joint #4)

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Soot To or Past O-rings?		✓	
B. Heat Affected Metal?		✓	
C. Foreign Material?		✓	
D. RTV in Contact With or Past the Primary O-ring?	✓		1
E. O-ring Damage (In Groove)?		✓	
F. Heat Affected or Eroded O-rings (In Groove)?		✓	
G. Excessive or No Grease?		✓	
H. Corrosion?	✓		2
I. Metal Damage?		✓	

Notes / Comments

1) RTV reached the primary O-ring between 105° – 362.5°

2) Light corrosion observed between the primary and secondary O-rings intermittent full circumference (Throat) Non-seal surface
Light-to-medium corrosion observed between the phenolic and secondary O-ring footprint intermittent full circumference (Forward Exit Cone)

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-5
Large Diameter (Joint) O-ring Condition (Detailed)

Motor No.: 360T028	Side: Right (B)	Date: 12-15-92

Assessment Engineer(s)/Inspector(s): Rocky Ash, Gordon Hyer, Marv Lyon

Joint: Throat-to-Forward Exit Cone (Joint #4)

	Yes	No	Comment #
Primary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Damage/Defects?		✓	
Secondary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Damage/Defects?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/Sil and Port Condition (At Removal)

Motor No.: 360T028	Side: Right (B)	Date: 12-15-92
Assessment Engineer(s)/Inspector(s): Rocky Ash, Gordon Hyer, Marv Lyon		
Location: Throat-to-Forward Exit Cone (Joint #4)		

Leak Check Plug Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		✓	
B. Soot To or Past O-ring?		✓	
C. Foreign Material?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Heat Affected or Eroded O-ring (In Groove)?		✓	
F. Excessive or No Grease on O-ring?		✓	
G. Excessive Grease on Plug?		✓	
H. Corrosion?		✓	
I. Thread Damage (Visible at Removal)?		✓	
Leak Check Port Observations:			
J. Sooted Metal Surfaces?		✓	
K. Foreign Material?		✓	
L. Excessive Grease?		✓	
M. Corrosion?		✓	
N. Metal Damage?		✓	
O. Heat Affected Metal?		✓	
P. Obstructed Through Hole?		✓	

Notes / Comments

Breakaway Torque - 40
Running Torque - 9

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/SII Condition (Detailed)

Motor No.: 360T028	Side: Right (B)	Date: 12-15-92

Assessment Engineer(s)/Inspector(s): Rocky Ash, Gordon Hyer, Marv Lyon

Location: Throat-to-Forward Exit Cone (Joint #4)

Leak Check Plug Observations:	Yes	No	Comment #
A. Foreign Material Between the O-ring and Plug?		✓	
B. Heat Affected Metal?		✓	
C. Seal Surface/Thread Damage?		✓	

Notes / Comments

Breakaway Torque : 40 in·lb
Running Torque : 9 in·lb

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

REVISION ____

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)

Motor No.: 360T028	Side: Right (B)	Date: 12-15-92

Assessment Engineer(s)/Inspector(s): Rocky Ash, Gordon Hyer, Marv Lyon

Location: Throat-to-Forward Exit Cone (Joint #4)

Secondary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-3
Internal Nozzle Joint Condition

Motor No.: 360T028	**Side:** Right (B)	**Date:** 12-15-92

Assessment Engineer(s)/Inspector(s): Rocky Ash, Gordon Hyer, Karl Shupe

Joint: Aft End Ring-to-Fixed Housing (Joint #5)

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Soot To or Past O-rings?		✓	
B. Heat Affected Metal?		✓	
C. Foreign Material?	/	✓	
D. RTV in Contact With or Past the Primary O-ring?	✓		1
E. O-ring Damage (In Groove)?		✓	
F. Heat Affected or Eroded O-rings (In Groove)?		✓	
G. Excessive or No Grease?		✓	
H. Corrosion?	✓		2
I. Metal Damage?		✓	

Notes / Comments

1) RTV reached the primary O-ring between 170-195 and 335-0-8 degrees.

2) Medium corrosion observed on the aft end flange I.D intermittent full circumference.

Preliminary PFAR(s)? ______ Yes ✓ No **Preliminary PFAR Number(s):** ______

Clarification Form(s)? ______ Yes ✓ No **Clarification Form Page No.(s):** ______

POSTFLIGHT OBSERVATION RECORD (PFOR) B-5
Large Diameter (Joint) O-ring Condition (Detailed)

Motor No.: 360T028	Side: Right (B)	Date: 12-15-92

Assessment Engineer(s)/Inspector(s): Rocky Ash, Gordon Hyer, Karl Shupe

Joint: Aft End Ring-to-Fixed Housing (Joint #5)

Primary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Damage/Defects?		✓	
Secondary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Damage/Defects?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes __✓__ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes __✓__ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/SII and Port Condition (At Removal)

Motor No.: 360T028	Side: Right (B)	Date: 12-15-92

Assessment Engineer(s)/Inspector(s): Rocky Ash, Gordon Hyer, Karl Shupe

Location: Aft End Ring-to-Fixed Housing (Joint #5)

Leak Check Plug Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		✓	
B. Soot To or Past O-ring?		✓	
C. Foreign Material?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Heat Affected or Eroded O-ring (In Groove)?		✓	
F. Excessive or No Grease on O-ring?		✓	
G. Excessive Grease on Plug?		✓	
H. Corrosion?		✓	
I. Thread Damage (Visible at Removal)?		✓	
Leak Check Port Observations:			
J. Sooted Metal Surfaces?		✓	
K. Foreign Material?		✓	
L. Excessive Grease?		✓	
M. Corrosion?		✓	
N. Metal Damage?		✓	
O. Heat Affected Metal?		✓	
P. Obstructed Through Hole?		✓	

Notes / Comments

Breakaway Torque - 37 in-lbs
Running Torque - 10 in-lbs

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/Sil Condition (Detailed)

Motor No.: 360T028	Side: Right (B)	Date: 12-15-92

Assessment Engineer(s)/Inspector(s): Rocky Ash, Gordon Hyer, Karl Shupe

Location: Aft End Ring-to-Fixed Housing (Joint #5)

Leak Check Plug Observations:

	Yes	No	Comment #
A. Foreign Material Between the O-ring and Plug?		✓	
B. Heat Affected Metal?		✓	
C. Seal Surface/Thread Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)

Motor No.: 360T028	Side: Right (B)	Date: 12-15-92

Assessment Engineer(s)/Inspector(s): Rocky Ash, Karl Shupe, Gordon Hyer

Location: Aft End Ring-to-Fixed Housing (Joint #5)

Secondary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

POSTFLIGHT OBSERVATION RECORD (PFOR) B-8
Packing With Retainer Condition (Detailed)

Motor No.: 360T028	Side: Right (B)	Date: 12-15-92
Assessment Engineer(s)/Inspector(s): Rocky Ash, Gordon Hyer, Karl Shupe		
Joint: Aft End Ring-to-Fixed Housing (Joint #5)		

Packing With Retainer Observations:	Yes	No	Comment #
A. Heat Affected or Eroded Seal or Retainer?		✓	
B. Seal or Retainer Damage/Defects?	✓		1
C. Corrosion?		✓	

Notes / Comments

1) Typical disassembly damage to all 72 packings with retainers rubber seal.

Preliminary PFAR(s)? ______ Yes __✓__ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes __✓__ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-9
Case Factory Joint Condition

Motor No.: 360T028	Side: Right (B)	Date: 4-22-93

Assessment Engineer(s)/Inspector(s): H. ZAREMBA

Factory Joint: Forward Dome

Case Factory Joint Observations:	Yes	No	Comment #
A. Heat Affected or Eroded Joint O-ring?		X	
B. Heavy Corrosion in Joint?		X	
C. Heavy Corrosion in Leak Check Port?		X	

Note: Heavy corrosion is defined as corrosion that causes pitting. It may be necessary to remove corrosion to determine if pitting has occurred; however, care should be taken not to damage the hardware. A cloth dampened with solvent or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

Preliminary PFAR(s)? ______ Yes ______ No Preliminary PFAR Number(s): ____________

Clarification Form(s)? ______ Yes ______ No Clarification Form Page No.(s): ____________

POSTFLIGHT OBSERVATION RECORD (PFOR) B-9
Case Factory Joint Condition

Motor No.: 360T028	Side: Right (B)	Date: 4-22-93
Assessment Engineer(s)/Inspector(s): H. ZAREMBA		
Factory Joint: Forward		

Case Factory Joint Observations:

	Yes	No	Comment #
A. Heat Affected or Eroded Joint O-ring?		X	
B. Heavy Corrosion in Joint?		X	
C. Heavy Corrosion in Leak Check Port?		X	

Note: Heavy corrosion is defined as corrosion that causes pitting. It may be necessary to remove corrosion to determine if pitting has occurred; however, care should be taken not to damage the hardware. A cloth dampened with solvent or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

Preliminary PFAR(s)? ______ Yes ______ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ______ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-9
Case Factory Joint Condition

Motor No.: 360T028	Side: Right (B)	Date: 7-13-93

Assessment Engineer(s)/Inspector(s): RICH

Factory Joint: Forward Center

Case Factory Joint Observations:	Yes	No	Comment #
A. Heat Affected or Eroded Joint O-ring?		X	
B. Heavy Corrosion in Joint?		X	
C. Heavy Corrosion in Leak Check Port?		X	

Note: Heavy corrosion is defined as corrosion that causes pitting. It may be necessary to remove corrosion to determine if pitting has occurred; however, care should be taken not to damage the hardware. A cloth dampened with solvent or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

Preliminary PFAR(s)? ______ Yes __X__ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes __X__ No Clarification Form Page No.(s): ______

POSTFLIGHT OBSERVATION RECORD (PFOR) B-9
Case Factory Joint Condition

Motor No.: 360T028	Side: Right (B)	Date: 6-22-93
Assessment Engineer(s)/Inspector(s): D. MARBLE		
Factory Joint: Aft Center		

Case Factory Joint Observations:

	Yes	No	Comment #
A. Heat Affected or Eroded Joint O-ring?		✓	
B. Heavy Corrosion in Joint?		✓	
C. Heavy Corrosion in Leak Check Port?		✓	

Note: Heavy corrosion is defined as corrosion that causes pitting. It may be necessary to remove corrosion to determine if pitting has occurred; however, care should be taken not to damage the hardware. A cloth dampened with solvent or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

NONE

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-9
Case Factory Joint Condition

Motor No.: 360T028	Side: Right (B)	Date: 04-01-93
Assessment Engineer(s)/Inspector(s): C. BROWN		
Factory Joint: ET Attach/Stiffener		

Case Factory Joint Observations:

	Yes	No	Comment #
A. Heat Affected or Eroded Joint O-ring?		✓	
B. Heavy Corrosion in Joint?		✓	
C. Heavy Corrosion in Leak Check Port?		✓	

Note: Heavy corrosion is defined as corrosion that causes pitting. It may be necessary to remove corrosion to determine if pitting has occurred; however, care should be taken not to damage the hardware. A cloth dampened with solvent or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments NONE

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): N/A

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): N/A

POSTFLIGHT OBSERVATION RECORD (PFOR) B-9
Case Factory Joint Condition

Motor No.: 360T028	Side: Right (B)	Date: 04-01-93
Assessment Engineer(s)/Inspector(s): C. BROWN		
Factory Joint: Stiffener/Stiffener		

<u>Case Factory Joint Observations:</u>

	Yes	No	Comment #
A. Heat Affected or Eroded Joint O-ring?		✓	
B. Heavy Corrosion in Joint?		✓	
C. Heavy Corrosion in Leak Check Port?		✓	

Note: Heavy corrosion is defined as corrosion that causes pitting. It may be necessary to remove corrosion to determine if pitting has occurred; however, care should be taken not to damage the hardware. A cloth dampened with solvent or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

NONE

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): N/A

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): N/A

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-9
Case Factory Joint Condition

Motor No.: 360T028	Side: Right (B)	Date: 04-01-93
Assessment Engineer(s)/Inspector(s): C. BROWN		
Factory Joint: Aft Dome		

<u>Case Factory Joint Observations:</u>

	Yes	No	Comment #
A. Heat Affected or Eroded Joint O-ring?		✓	
B. Heavy Corrosion in Joint?		✓	
C. Heavy Corrosion in Leak Check Port?		✓	

Note: Heavy corrosion is defined as corrosion that causes pitting. It may be necessary to remove corrosion to determine if pitting has occurred; however, care should be taken not to damage the hardware. A cloth dampened with solvent or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

NONE

ENTERED WRONG BOX
103
04-01-93

Preliminary PFAR(s)? ✓ Yes ✓ No Preliminary PFAR Number(s): N/A

Clarification Form(s)? ✓ Yes ✓ No Clarification Form Page No.(s): N/A

POSTFLIGHT OBSERVATION RECORD (PFOR) B-10
Case Y-Joint Condition

Motor No.: 360T028	Side: Right (B)	Date: 31 Aug 93
Assessment Engineer(s)/Inspector(s): NA		
Y-Joint: Forward Dome		

Case Y-Joint Observations:

	Yes	No	Comment #
A. Corrosion?	NA	NA	1

Notes / Comments

Special Issue 3.2.1.1

1. Assessment was not Done.

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ____________

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ____________

POSTFLIGHT OBSERVATION RECORD (PFOR) B-10
Case Y-Joint Condition

Motor No.: 360T028	Side: Right (B)	Date:

Assessment Engineer(s)/Inspector(s):

Y-Joint: Aft Dome

Case Y-Joint Observations:	Yes	No	Comment #
A. Corrosion?	____	____	____

Notes / Comments

Special Issue 3.2.1.1

Preliminary PFAR(s)? ______ Yes ______ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ______ No Clarification Form Page No.(s): ______

TWR-64216

Solid Rocket Motor
Thiokol Corporation

Appendix C
Nozzle PFORs

Final Postflight Hardware Evaluation Report
RSRM-28 (STS-53)

November 1993

Prepared for:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER
MARSHALL SPACE FLIGHT CENTER, ALABAMA 35812

Contract No.	NAS8-38100
DR No.	4-23
WBS No.	4C601-04-01
ECS No.	SS4771

Thiokol CORPORATION
SPACE OPERATIONS

P.O. Box 707, Brigham City, Utah 84302-0707 (801) 863-3511

NOZZLE REQUIRED EVALUATION FORMS LIST

PFOR #	Title	Side	Joint, Part, or Location	Final Report Page Number
C-1	Nozzle Assembly Quick-look Condition	Left	N/A	C-1
C-2	Nozzle Joint Condition	Left	Joint #2	C-2
C-3	Nose Inlet-to-Flex Bearing-to-Cowl Joint Condition Drawing Worksheet	Left	Joint #2	C-3
C-2	Nozzle Joint Condition	Left	Joint #3	C-4
C-4	Nose Inlet-to-Throat Joint Condition Drawing Worksheet	Left	Joint #3	C-5
C-2	Nozzle Joint Condition	Left	Joint #4	C-6
C-5	Throat-to-Forward Exit Cone Joint Condition Drawing Worksheet	Left	Joint #4	C-7
C-2	Nozzle Joint Condition	Left	Joint #5	C-8
C-6	Aft End Ring-to-Fixed Housing Joint Condition Drawing Worksheet	Left	Joint #5	C-9
C-7	Cowl Insulation Segment Condition	Left	Cowl	C-10
C-8	Flexible Bearing, Flexible Bearing Protector, and Flexible Boot Condition	Left	Flexible Bearing, Protector, & Boot	C-11
C-9	Flexible Bearing Protector Thickness Measurements	Left	Flexible Bearing Protector	C-12
C-10	Throat Diameter Measurements	Left	Throat	C-13

(Note: Clarification PFORs will be inserted after the applicable required PFOR in the Final Report and will have the same page number as the required PFOR appended by a sequential alphabetic extension.)

NOZZLE REQUIRED EVALUATION FORMS LIST (Cont.)

PFOR #	Title	Side	Joint, Part, or Location	Final Report Page Number
C–11	Outer Boot Ring Char and Erosion Measurements and Flexible Boot Condition	Left	Outer Boot Ring & Flexible Boot	C–14
C–12	Nozzle Subassembly Phenolic Bondline Condition	Left	Aft Exit Cone	C–15
C–12	Nozzle Subassembly Phenolic Bondline Condition	Left	Forward Exit Cone	C–16
C–12	Nozzle Subassembly Phenolic Bondline Condition	Left	Throat	C–17
C–12	Nozzle Subassembly Phenolic Bondline Condition	Left	Forward Nose & Aft Inlet Rings	C–18
C–12	Nozzle Subassembly Phenolic Bondline Condition	Left	Nose Cap	C–19
C–12	Nozzle Subassembly Phenolic Bondline Condition	Left	Cowl	C–20
C–12	Nozzle Subassembly Phenolic Bondline Condition	Left	Fixed Housing	C–21
C–13	Cowl Ring Phenolic (SCP) Section Condition	Left	Cowl	C–22
C–14	Forward Exit Cone Phenolic (CCP) Section Condition	Left	Forward Exit Cone	C–23
C–15	Fixed Housing Phenolic (CCP) Section Condition	Left	Fixed Housing	C–24
C–16	Throat Inlet Assembly Phenolic (CCP) Section Condition	Left	Throat	C–25
C–17	Nose Cap Phenolic (CCP) Section Condition	Left	Nose Cap	C–26
C–18	Forward Nose Ring and Aft Inlet Ring Phenolic (CCP) Section Condition	Left	Forward Nose & Aft Inlet Rings	C–27
	Aft Exit Cone Phenolic (CCP) Condition	Left	Aft Exit Cone	C–55

(Note: Clarification PFORs will be inserted after the applicable required PFOR in the Final Report and will have the same page number as the required PFOR appended by a sequential alphabetic extension.)

NOZZLE REQUIRED EVALUATION FORMS LIST (Cont.)

PFOR #	Title	Side	Joint, Part, or Location	Final Report Page Number
C–1	Nozzle Assembly Quick-look Condition	Right	N/A	C–28
C–2	Nozzle Joint Condition	Right	Joint #2	C–29
C–3	Nose Inlet-to-Flex Bearing-to-Cowl Joint Condition Drawing Worksheet	Right	Joint #2	C–30
C–2	Nozzle Joint Condition	Right	Joint #3	C–31
C–4	Nose Inlet-to-Throat Joint Condition Drawing Worksheet	Right	Joint #3	C–32
C–2	Nozzle Joint Condition	Right	Joint #4	C–33
C–5	Throat-to-Forward Exit Cone Joint Condition Drawing Worksheet	Right	Joint #4	C–34
C–2	Nozzle Joint Condition	Right	Joint #5	C–35
C–6	Aft End Ring-to-Fixed Housing Joint Condition Drawing Worksheet	Right	Joint #5	C–36
C–7	Cowl Insulation Segment Condition	Right	Cowl	C–37
C–8	Flexible Bearing, Flexible Bearing Protector, and Flexible Boot Condition	Right	Flexible Bearing, Protector, & Boot	C–38
C–9	Flexible Bearing Protector Thickness Measurements	Right	Flexible Bearing Protector	C–39
C–10	Throat Diameter Measurements	Right	Throat	C–40

(Note: Clarification PFORs will be inserted after the applicable required PFOR in the Final Report and will have the same page number as the required PFOR appended by a sequential alphabetic extension.)

NOZZLE REQUIRED EVALUATION FORMS LIST (Cont.)

PFOR #	Title	Side	Joint, Part, or Location	Final Report Page Number
C-11	Outer Boot Ring Char and Erosion Measurements and Flexible Boot Condition	Right	Outer Boot Ring & Flexible Boot	C-41
C-12	Nozzle Subassembly Phenolic Bondline Condition	Right	Aft Exit Cone	C-42
C-12	Nozzle Subassembly Phenolic Bondline Condition	Right	Forward Exit Cone	C-43
C-12	Nozzle Subassembly Phenolic Bondline Condition	Right	Throat	C-44
C-12	Nozzle Subassembly Phenolic Bondline Condition	Right	Forward Nose & Aft Inlet Rings	C-45
C-12	Nozzle Subassembly Phenolic Bondline Condition	Right	Nose Cap	C-46
C-12	Nozzle Subassembly Phenolic Bondline Condition	Right	Cowl	C-47
C-12	Nozzle Subassembly Phenolic Bondline Condition	Right	Fixed Housing	C-48
C-13	Cowl Ring Phenolic (SCP) Section Condition	Right	Cowl	C-49
C-14	Forward Exit Cone Phenolic (CCP) Section Condition	Right	Forward Exit Cone	C-50
C-15	Fixed Housing Phenolic (CCP) Section Condition	Right	Fixed Housing	C-51
C-16	Throat Inlet Assembly Phenolic (CCP) Section Condition	Right	Throat	C-52
C-17	Nose Cap Phenolic (CCP) Section Condition	Right	Nose Cap	C-53
C-18	Forward Nose Ring and Aft Inlet Ring Phenolic (CCP) Section Condition	Right	Forward Nose & Aft Inlet Rings	C-54
N/A	Aft Exit Cone Assembly Phenolic (CCP) Section Condition	Left	Aft Exit Cone	C-55

(Note: Clarification PFORs will be inserted after the applicable required PFOR in the Final Report and will have the same page number as the required PFOR appended by a sequential alphabetic extension.)

POSTFLIGHT OBSERVATION RECORD (PFOR) C-1
Nozzle Assembly Quick-look Condition

Motor No.: 360L028	Side: ☒ Left (A) ☐ Right (B)	Date: 12-14-92
Assessment Engineer(s)/Inspector(s): M.E. CLARK		

Nozzle Assembly Quick-look Observations:

	Yes	No	Comment #
A. Metal Damage Due to Transportation or Handling?		✓	
B. Phenolic Damage Due to Transportation or Handling?	✓		1
C. Foreign Material?		✓	

Notes / Comments

1) Very minor damage to small portion of FEC phenolic that remains on the aft end. No erosion and char measurements will be taken in these areas. Tie-down chains rubbed through covering.

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ________

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-2
Internal Nozzle Joint Condition

Motor No.: 360T028	Side: Left (A)	Date: 12/15/92
Assessment Engineer(s)/Inspector(s): J. WALKER P. MILLER, M. Clark		
Joint: Nose Inlet-to-Flex Bearing-to-Cowl (Joint #2)		

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Gas Penetration in the RTV (Terminated, Through)?		✓	
B. RTV Not Below Char Line?		✓	
C. RTV To the Primary O-ring?		✓	
D. RTV Past the Primary O-ring?		✓	
E. Uncured RTV?		✓	
F. Voids Within RTV?		✓	
G. Foreign Material?		✓	
H. Heat Affected or Eroded Virgin CCP, GCP/SCP, or adhesive?		✓	
I. Damaged Phenolics?		✓	
J. Bondline Edge Separations? Use Clarification Form.		✓	
K. Phenolics Axially Displaced From Housing?		✓	
L. Heat Affected Metal?		✓	
M. Unbonded or Blistered Paint?	✓		2
N. Corrosion?	✓		1
O. Excessive Grease in Threaded Bolt Holes?		✓	
P. Bolt Hole Damage (Through, Threaded/Helical Coil Insert)?		✓	
Q. Bent or Broken Bolts?		✓	
R. Metal Damage (Joints or Housings)?		✓	

Notes / Comments

1) Light-to-heavy corrosion observed. Reference page C-3 for locations.

2) Bubbled paint was observed. Reference page C-3
A preliminary PFAR was written.

Preliminary PFAR(s)? ✓ Yes ___ No   Preliminary PFAR Number(s): S3C-02

Clarification Form(s)? ___ Yes ✓ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-3

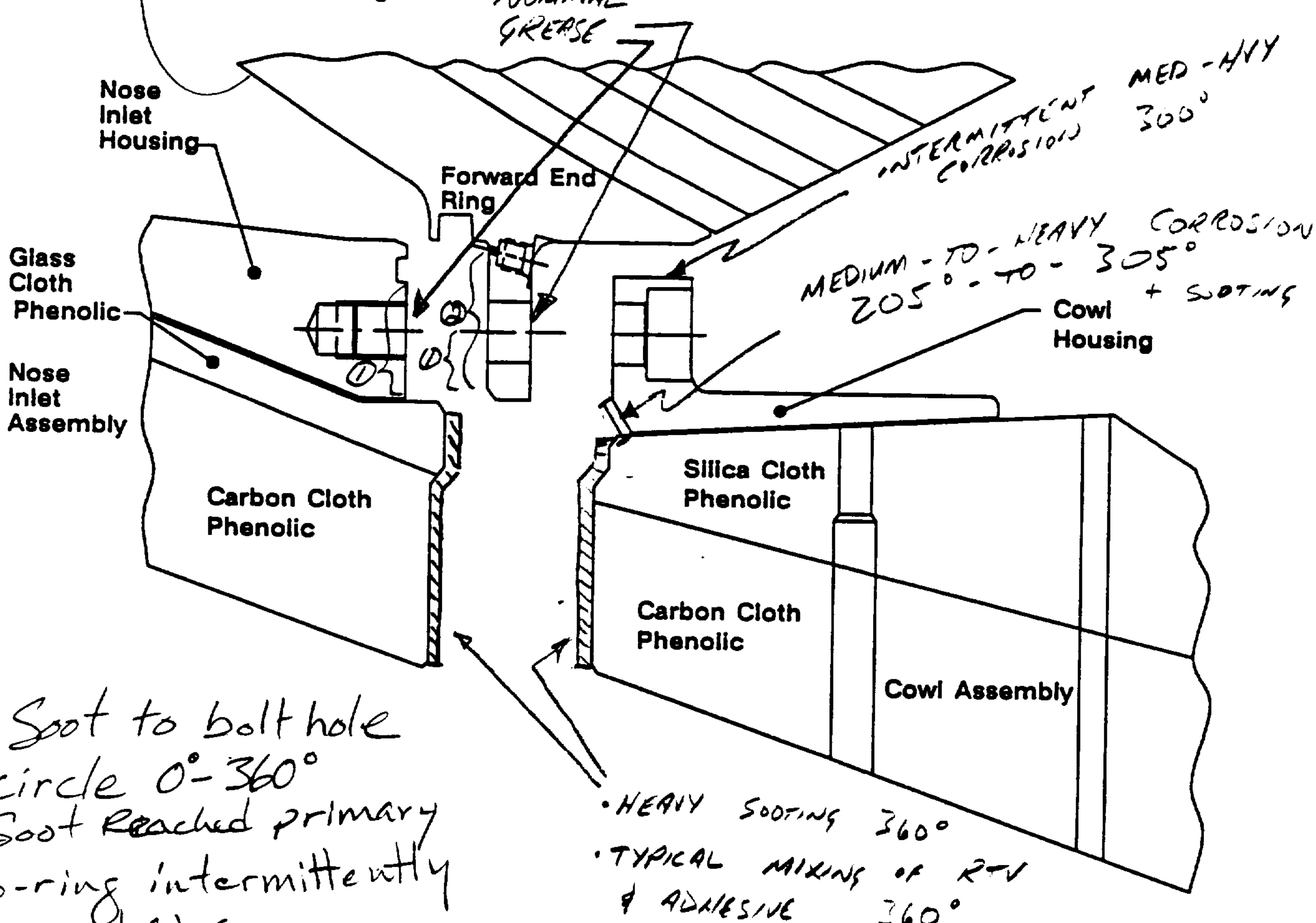
Nose Inlet-to-Flex Bearing-to-Cowl Joint (Joint #2) Condition Drawing Worksheet

Motor No.: 360T028	Side: Left (A)	Date: 12/15/92
Assessment Engineer(s)/Inspector(s):	J. WALKER P. MILLER M. Clark	

Sketch Observations Below (include locations and sizes of sketched features):

Intermittent bubbled paint 0°-360° 0.10" max. Both top coat and primer bubbled. No corrosion on surface below bubbles. No sign of heat affects

Clear Fluid was present in the bubbles. A sample was taken with a syringe



1) Soot to bolt hole circle 0°-360° Soot Reached primary o-ring intermittently around circ.

2) Light corrosion 0°-360°

Clarification Form(s)? ______ Yes ___✓___ No Clarification Form Page No.(s): ____________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-2
Internal Nozzle Joint Condition

Motor No.: 360T028	Side: Left (A)	Date: 12-16-92
Assessment Engineer(s)/Inspector(s): M. E. Clark, P. Miller		
Joint: Nose Inlet-to-Throat (Joint #3)		

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Gas Penetration in the RTV (Terminated, Through)?		✓	
B. RTV Not Below Char Line?		✓	
C. RTV To the Primary O-ring?		✓	
D. RTV Past the Primary O-ring?		✓	
E. Uncured RTV?		✓	
F. Voids Within RTV?		✓	
G. Grease Inhibiting RTV Backfill?		✓	
H. Foreign Material?		✓	
I. Heat Affected or Eroded Virgin CCP, GCP/SCP, or adhesive?		✓	
J. Damaged Phenolics?		✓	
K. Bondline Edge Separations? Use Clarification Form.	✓		1
L. Phenolics Axially Displaced From Housing?		✓	
M. Heat Affected Metal?		✓	
N. Unbonded or Blistered Paint?	✓		2
O. Corrosion?	✓		3
P. Alignment Pin Damage?		✓	
Q. Excessive Grease in Threaded Bolt Holes?		✓	
R. Bolt Hole Damage (Through, Threaded/Helical Coil Insert)?		✓	
S. Bent or Broken Bolts?		✓	
T. Metal Damage (Joints or Housings)?		✓	

Notes / Comments

1) Separations documented on page C-4A
2) Bubbled paint observed on O.D. surface of throat flange. Reference page C-5. A preliminary PFAR was written.
3) Corrosion observed. Reference page C-5.

Preliminary PFAR(s)? ✓ Yes ___ No — Preliminary PFAR Number(s): 53C-04

Clarification Form(s)? ✓ Yes ___ No — Clarification Form Page No.(s): C-4A

Nozzle Interface Separation Clarification Form

Motor No.: 360T028 | Side: ☒ Left (A) ☐ Right (B) | Date: 12-16-92

Assessment Engineer(s)/Inspector(s): M. Clark

Part:
- ☐ Forward Exit Cone (Forward End)
- ☐ Throat Ring (Aft End)
- ☒ Throat Inlet Ring (Forward End)
- ☐ Aft Inlet Ring (Aft End)
- ☐ Nose Cap (Aft End)
- ☐ Cowl (Forward End)*
- ☐ Inner Boot Ring (Forward End)

Interface Separation Types:

A. Metal-to-Adhesive
B. Within Adhesive
C. Adhesive-to-GCP
D. Within GCP
E. GCP-to-CCP
F. Within CCP
*G. Adhesive-to-SCP
*H. Within SCP
*I. SCP-to-CCP

Circumferential Location	Separation Type	Maximum Radial Width
0-360	A	0.010

Corresponding Comment Number(s): ______

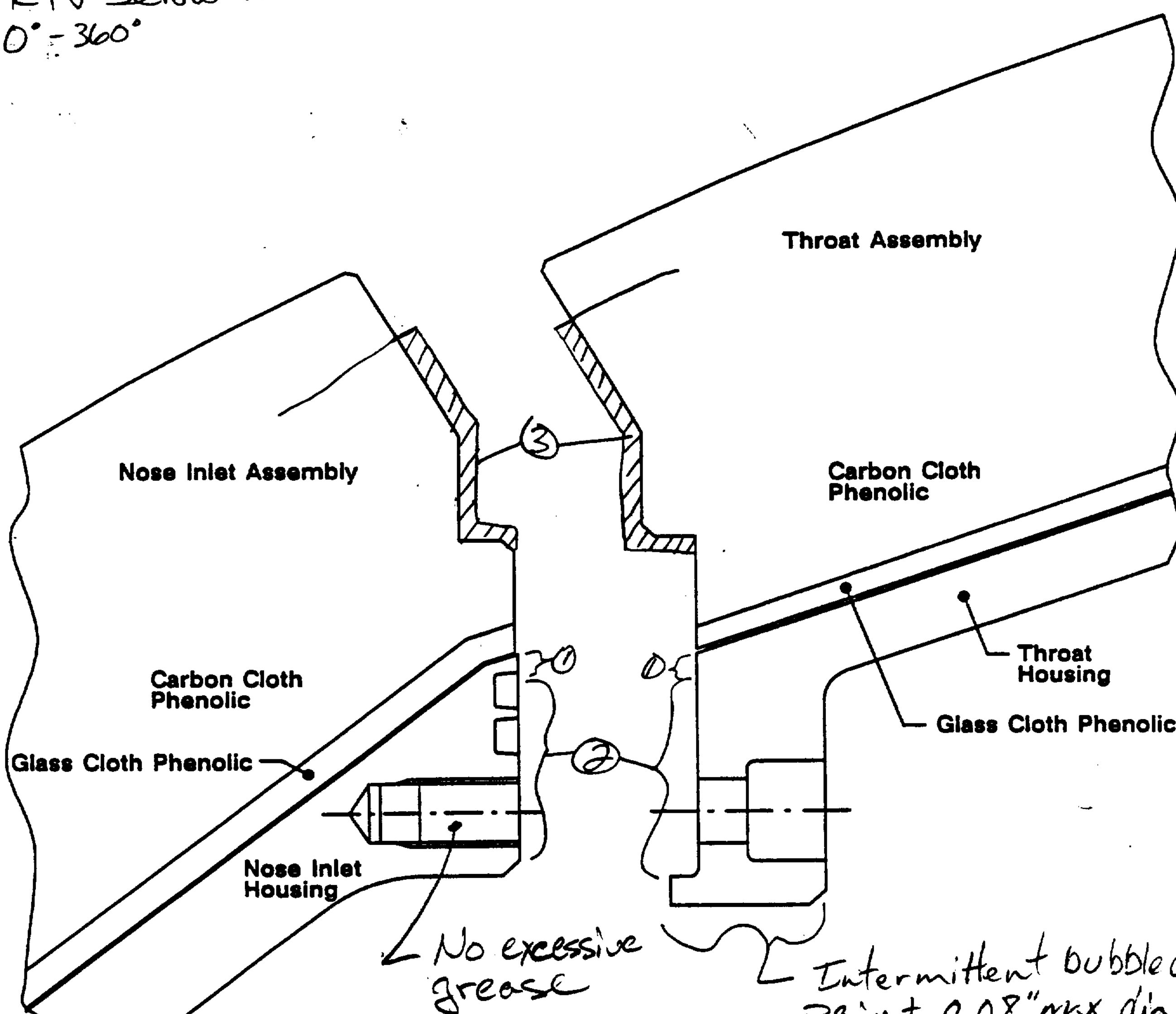
Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-4
Nose Inlet-to-Throat Joint (Joint #3) Condition Drawing Worksheet

Motor No.: 360T028	Side: Left (A)	Date: 12-16-92
Assessment Engineer(s)/Inspector(s): M.E. Clark, P. Miller		

Sketch Observations Below (include locations and sizes of sketched features):

3) RTV below the charline
0°-360°



1) Intermittent Light-to-medium corrosion around the arc.
2) Nominal grease coverage with no corrosion.

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ________

REVISION ____

POSTFLIGHT OBSERVATION RECORD (PFOR) C-2

Internal Nozzle Joint Condition

Motor No.: 360L028 | Side: ☒ Left (A) ☐ Right (B) | Date: 12-15-92

Assessment Engineer(s)/Inspector(s): M.E. Clark

Joint: ☐ Nose Inlet-to-Flex Bearing-to-Cowl (Joint #2) ☒ Throat-to-Forward Exit Cone (Joint #4)
☐ Nose Inlet-to-Throat (Joint #3) ☐ Aft End Ring-to-Fixed Housing (Joint #5)

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Gas Penetration in the RTV (Terminated, Through)?		✓	
B. RTV Not Below Char Line?		✓	
C. RTV To the Primary O-ring?	✓		1
D. RTV Past the Primary O-ring?		✓	
E. Uncured RTV?		✓	
F. Voids Within RTV?		✓	
G. Grease Inhibiting RTV Backfill (Joints 3 and 4)?		✓	
H. Foreign Material?		✓	
I. Heat Affected or Eroded Virgin CCP, GCP/SCP, or adhesive?		✓	
J. Damaged Phenolics?		✓	
K. Bondline Edge Separations? Use Clarification Form.	✓		2
L. Phenolics Axially Displaced From Housing?		✓	
M. Heat Affected Metal?		✓	
N. Unbonded or Blistered Paint?		✓	
O. Corrosion?	✓		3
P. Alignment Pin Damage (Joints 3, 4, and 5)?		✓	
Q. Excessive Grease in Threaded Bolt Holes?		✓	
R. Bolt Hole Damage (Through, Threaded/Helical Coil Insert)?		✓	
S. Bent or Broken Bolts?		✓	
T. Metal Damage (Joints or Housings)?		✓	

Notes / Comments

1) RTV reached primary o-ring at 37.5°-165° and 247.5°-347.5°
2) Separations documented on pages C-6A and C-6B
3) Light-to-medium corrosion observed. Reference page C-7 for locations.

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ✓ Yes ____ No Clarification Form Page No.(s): C-6A & C-6B

Nozzle Interface Separation Clarification Form

Motor No.: 360L028 | Side: [X] Left (A) [ ] Right (B) | Date: 12-15-92

Assessment Engineer(s)/Inspector(s): M.E. Clark

Part:
- [X] Forward Exit Cone (Forward End)
- [ ] Throat Ring (Aft End)
- [ ] Throat Inlet Ring (Forward End)
- [ ] Aft Inlet Ring (Aft End)
- [ ] Nose Cap (Aft End)
- [ ] Cowl (Forward End)*
- [ ] Inner Boot Ring (Forward End)

Interface Separation Types:

A. Metal-to-Adhesive
B. Within Adhesive
C. Adhesive-to-GCP
D. Within GCP
E. GCP-to-CCP
F. Within CCP
*G. Adhesive-to-SCP
*H. Within SCP
*I. SCP-to-CCP

Circumferential Location	Separation Type	Maximum Radial Width
0°-247.5°	A	0.050"
262.5°-360°	A	0.050"
247.5°-262.5°	C	0.020
100°-140°	E	0.020

Corresponding Comment Number(s): ____

Nozzle Interface Separation Clarification Form

Motor No.: 360L028	Side: ☒ Left (A) ☐ Right (B)	Date: 12-15-92

Assessment Engineer(s)/Inspector(s): M. E. Clark

Part:
- ☐ Forward Exit Cone (Forward End)
- ☒ Throat Ring (Aft End)
- ☐ Throat Inlet Ring (Forward End)
- ☐ Aft Inlet Ring (Aft End)
- ☐ Nose Cap (Aft End)
- ☐ Cowl (Forward End)*
- ☐ Inner Boot Ring (Forward End)

Interface Separation Types:

A. Metal-to-Adhesive
B. Within Adhesive
C. Adhesive-to-GCP
D. Within GCP
E. GCP-to-CCP
F. Within CCP
*G. Adhesive-to-SCP
*H. Within SCP
*I. SCP-to-CCP

Circumferential Location	Separation Type	Maximum Radial Width
0-360	A	0.010"

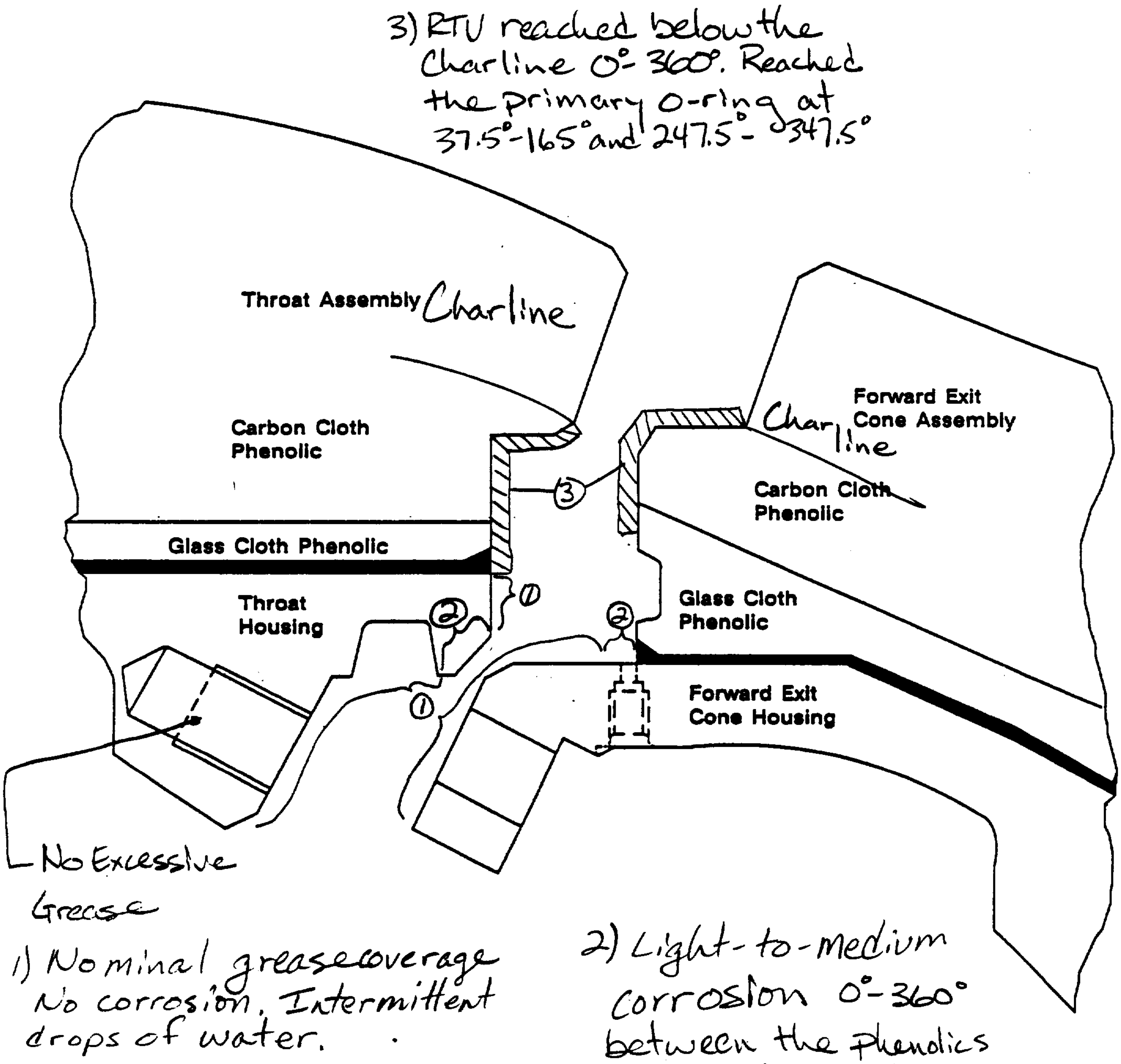
Corresponding Comment Number(s): ____________

POSTFLIGHT OBSERVATION RECORD (PFOR) C-5

Throat-to-Forward Exit Cone Joint (Joint #4) Condition Drawing Worksheet

Motor No.: 360L028	Side: ☒ Left (A) ☐ Right (B)	Date: 12-15-92
Assessment Engineer(s)/Inspector(s): M. E. Clark		

Sketch Observations Below (include locations and sizes of sketched features):



1) Nominal grease coverage No corrosion, Intermittent drops of water.

2) Light-to-medium corrosion 0°-360° between the phenolics and secondary o-ring

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-2
Internal Nozzle Joint Condition

Motor No.: 360T028	Side: Left (A)	Date: 12-15-92
Assessment Engineer(s)/Inspector(s): M. Clark, J. Passman		
Joint: Aft End Ring-to-Fixed Housing (Joint #5)		

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Gas Penetration in the RTV (Terminated, Through)?		✓	
B. RTV Not Below Char Line?		✓	
C. RTV To the Primary O-ring?	✓		1
D. RTV Past the Primary O-ring?		✓	
E. Uncured RTV?		✓	
F. Voids Within RTV?	✓		2
G. Foreign Material?		✓	
H. Heat Affected or Eroded Virgin CCP, GCP/SCP, or adhesive?		✓	
I. Damaged Phenolics?		✓	
J. Bondline Edge Separations? Use Clarification Form.		✓	
K. Phenolics Axially Displaced From Housing?		✓	
L. Heat Affected Metal?		✓	
M. Unbonded or Blistered Paint?		✓	
N. Corrosion?	✓		3
O. Alignment Pin Damage?		✓	
P. Excessive Grease in Threaded Bolt Holes?		✓	
Q. Bolt Hole Damage (Through, Threaded/Helical Coil Insert)?		✓	
R. Bent or Broken Bolts?		✓	
S. Metal Damage (Joints or Housings)?		✓	

Notes / Comments

1) RTV reach primary O-ring at 205°-260° and 20°-85°
2) Intermittent voids in the RTV due to assembly process.
3) Medium Corrosion observed on flex bearing. Reference page C-9 for location

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-6
Aft End Ring-to-Fixed Housing Joint (Joint #5) Condition Drawing Worksheet

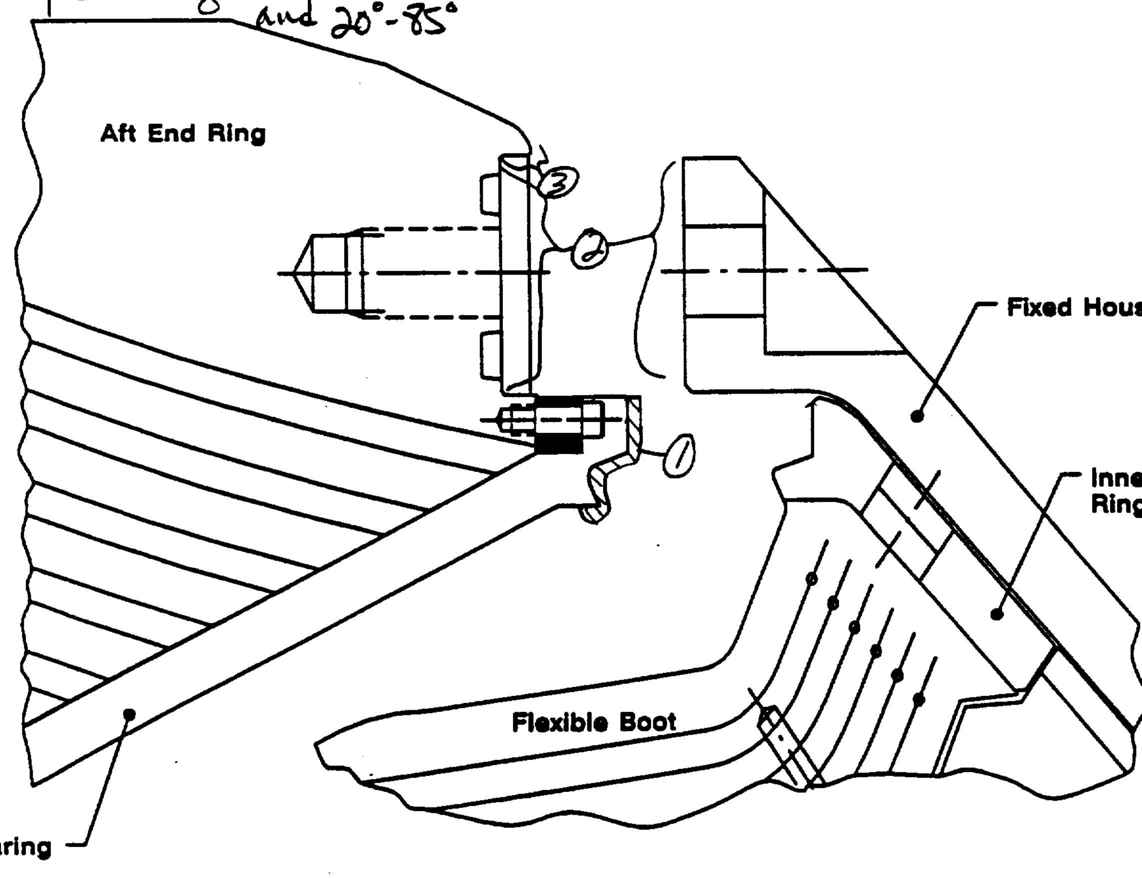
Motor No.: 360T028	Side: Left (A)	Date: 12-15-92
Assessment Engineer(s)/Inspector(s): M. Clark, J. Passman		

Sketch Observations Below (include locations and sizes of sketched features):

1) Nominal RTV coverage with intermittent voids due to the assembly process. RTV reached primary O-ring at 205°-260° and 20°-85°

2) Nominal grease coverage with no corrosion

3) Intermittent medium corrosion 0°-360°



Clarification Form(s)? _____ Yes __✓__ No   Clarification Form Page No.(s): ________

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-7
Cowl Insulation Segment Condition

Motor No.: 360T028	Side: Left (A)	Date: 12/15/92
Assessment Engineer(s)/Inspector(s): M.E. Clark, J. Passman, J. Walker, P. Miller		

Cowl Insulation Segment Observations:

	Yes	No	Comment #
A. Spring Pin Holes Completely Through the Cowl Segment?		✓	3
B. Abnormal Heat Effects or Erosion?		✓	
C. Soot Between the Cowl Segment and Cowl Housing?		✓	
D. Bondline Failure Mode? Data Collection Only.	N/A	N/A	2

Notes / Comments

1) bubbles observed on the cowl segment I.D. surface at 90°-170°.

2) BONDLINE FAILURE MODE: 20% COHESIVE WITHIN SEGMENTS
70% ADHESIVE - TO - SEGMENTS
10% ADHESIVE - TO - METAL

3. 17 OF THE SPRING PIN-HOLES WERE BETWEEN .150 - .200 DEEP

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-8
Flexible Bearing, Flexible Bearing Protector, and Flexible Boot Condition

Motor No.: 360T028	Side: Left (A)	Date: 12-15-92

Assessment Engineer(s)/Inspector(s): M.E. Clark, J. Passman

Flexible Bearing, Bearing Protector, and Boot Observations:	Yes	No	Comment #
A. Bearing Protector Burn-Through?		✓	
B. Cracks Through the Bearing Protector?		✓	
C. Bearing Protector Heat Effects or Erosion Other Than at Cowl Vent Hole Locations?	✓	✓	1
D. Soot Between the Bearing Protector and Flexible Bearing?		✓	
E. Heat Effects to the Flexible Bearing?		✓	
F. Bent or Broken Bearing Protector Bolts?		✓	
G. Flexible Boot Burn-Through?		✓	
H. Abnormal Heat Effects or Erosion to Flexible Boot ID?	✓		1
I. Foreign Material in Boot Cavity?		✓	

Notes / Comments

1) Erosion on the bearing protector other than the belly band at 150° and 178°-185°. Corresponding areas on flex boot. Appears that slag was trapped between the boot and bearing protector. Slag found in the boot cavity. Preliminary PFAR was written.

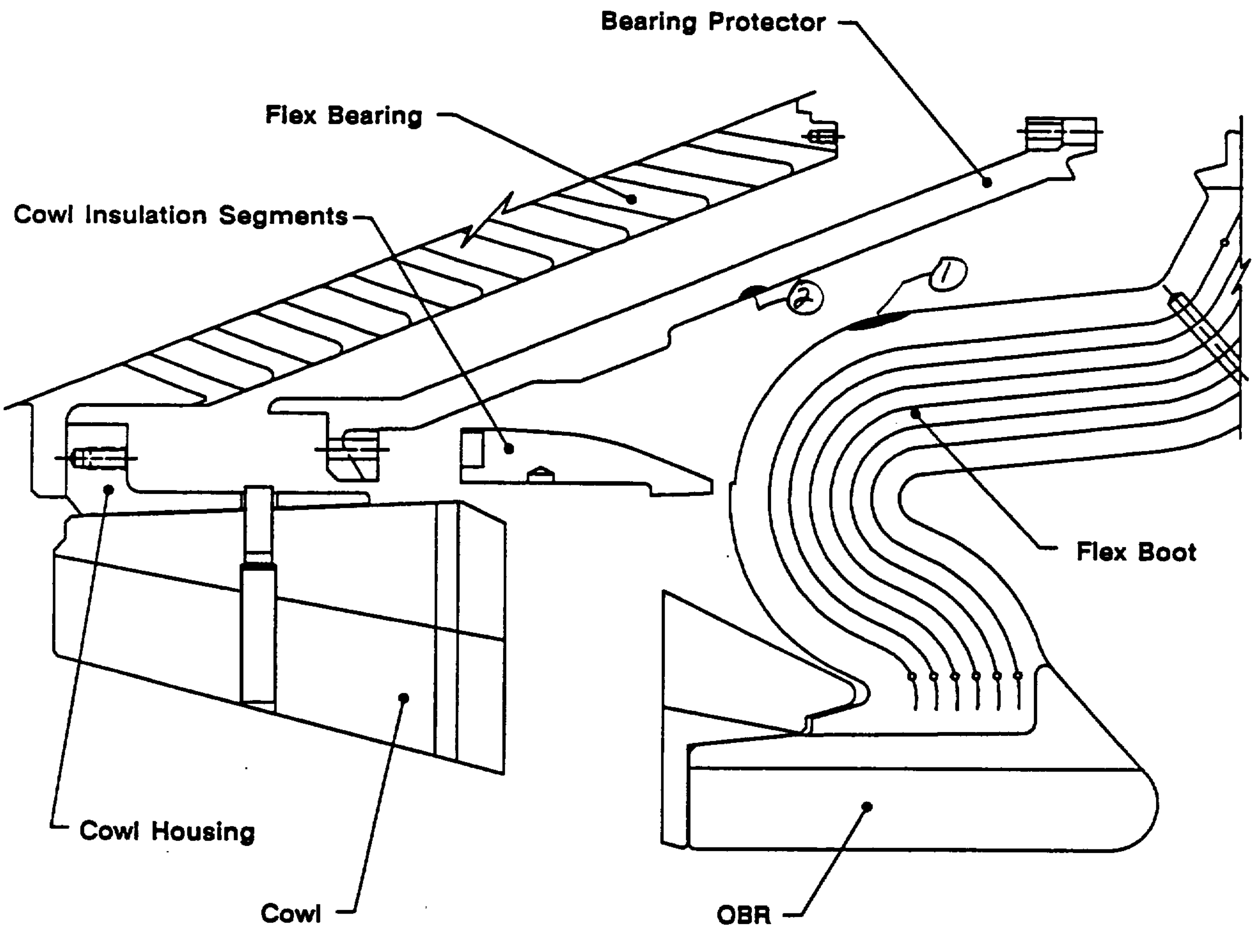
Preliminary PFAR(s)? ✓ Yes ____ No   Preliminary PFAR Number(s): 53C-01

Clarification Form(s)? ✓ Yes ____ No   Clarification Form Page No.(s): C-11A

Flexible Boot Cavity Clarification Form

Motor No.: 360T028	Side: ☒ Left (A) ☐ Right (B)	Date: 12-15-92
Assessment Engineer(s)/Inspector(s): M. Clark, J. Passman		
Description: Flex boot cavity conditions, Erosion on bearing protector and flex boot		

Sketch Observations Below (include locations and sizes of sketched features):



2) Erosion on bearing protector at:
a) 150°, 1.8" aft of belly band
1.5" circ. x 1.1" axial
b) 178°-195°, 1.8" aft of belly band
5.4" circ. x 1.3" axial

1 180° 5.4" CIRC x 1.1" AXIAL
150° 1.7" CIRC. x 1.2" AXIAL
Erosion on flex boot
Appears that slag was trapped between the boot and bearing protector

Corresponding Comment Number(s): ____________

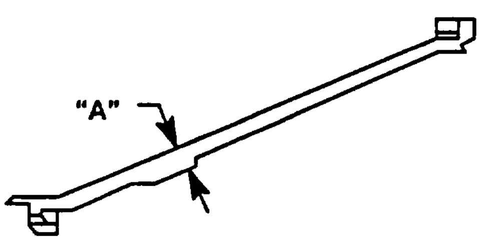
Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-9
Flexible Bearing Protector Thickness Measurements

Motor No.: 360T028	Side: Left (A)	Date: 12-16-92
Assessment Engineer(s)/Inspector(s): Jed Benson, R.R. Gallegos		

Record the Flexible Bearing Protector Gas Impingement Area Thickness Measurements (see figure) Below:

Degree Location	Thickness Measurement "A"* (inches)	Degree Location	Thickness Measurement "A"* (inches)	Degree Location	Thickness Measurement "A"* (inches)
0	.724"	120	.745"	240	.734"
10	.692"	130	.746"	250	.724"
20	.738"	140	.735"	260	.747"
30	.735"	150	.735"	270	.736"
40	.740"	160	.738"	280	.744"
50	.732"	170	.741"	290	.735"
60	.731"	180	.740"	300	.720"
70	.745"	190	.738"	310	.714"
80	.752"	200	.750"	320	.709"
90	.748"	210	.742"	330	.715"
100	.746"	220	.732"	340	.734"
110	.752"	230	.733"	350	.729"



* "A" is the minimum thickness of the bearing protector in-line with the cowl vent holes. It corresponds to the deepest gas impingement location.

Notes / Comments

NONE

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-10
Throat Diameter Measurements (Data Collection Only)

Motor No.: 360T028	Side: Left (A)	Date: 12-16-92
Assessment Engineer(s)/Inspector(s): MIGUEL ENRIQUEZ JR.		

Record the Nozzle Throat Diameter Measurements Below:

Degree Location	Diameter Measurement (Inches)
0	55.960"
45	55.970"
90	55.955"
135	55.955"

Notes / Comments

Clarification Form(s)? _____ Yes ✓ No   Clarification Form Page No.(s): _____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-11
Outer Boot Ring Char and Erosion Measurements and Flexible Boot Condition

Motor No.: 360T028	Side: Left (A)	Date: 5/20/93
Assessment Engineer(s)/Inspector(s): R. Quick		

Flexible Boot/Outer Boot Ring Separation Observations:

	Yes	No	Comment #
A. Heat Effects in Boot/OBR Separation?		✓	

Record the Outer Boot Ring Char and Erosion Measurements Below:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
8.0	.02	1.07	.08	.93	.02	.95	.02	.85
9.0	.04	.94	.06	.84	.02	.82	.0	.81
10.0	.03	.91	.03	.80	0	.78	.0	.84
11.3	.01	93	.04	.81	.02	.88	.0	87

Negative Margin of Safety? ______ Yes ✓ No Station: ______ Degree: ______

Record the Number of Plies Remaining on the Flexible Boot:

Degree Location	Plies Remaining
0	3.8
90	3.1
180	3.8
270	3.0

Negative Margin of Safety? ______ Yes ✓ No Degree: ______

Notes / Comments

Special Issue 3.3.9: NO ABNORMAL EROSION WAS OBSERVED

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

REVISION ___

POSTFLIGHT OBSERVATION RECORD (PFOR) C-12
Nozzle Subassembly Phenolic Bondline Condition

Motor No.: 360T028 | Side: Left (A) | Date: 1-8-93

Assessment Engineer(s)/Inspector(s): WILKES / MILLER

Phenolic Subassembly: Aft Exit Cone Assembly

Record Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

Degree Location

	0-360							
Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-GCP								
Within GCP	100%							
GCP-to-CCP								
Within CCP								

Record Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

Degree Location

	45-135	135-225	225-315	315-45				
Metal-to-Adhesive	5	10	4	6				
Within Adhesive	1	2	1	1				
Adhesive-to-GCP	94	88	95	93				

Phenolic Removal Method: MUCH HAMMER, WEDGE & PEEL (TYPICAL)

Metal Housing Bondline Surface Observations:	Yes	No	Comment #
A. Soot?		✓	
B. Voids in Adhesive?	✓		1
C. Corrosion?		✓	
D. Foreign Material?		✓	
E. Voids in Polysulfide (Aft Exit Cone Polysulfide Groove)?	✓		2

Notes / Comments (1) SEE PFOR CLARIFICATION FORM PAGE C-15A

(2) TYPICAL .150 DIA MAX. POLYSULFIDE VOIDS THROUGHOUT LENGTH & CIRCUMFERENCE. UNFILLED VOID INTERMITTENTLY AROUND CIRCUMFERENCE AT AFT .200 MAX EXCEPT ONE "V" SHAPE VOID AT 195° EXTENDED TO .400 MAX FROM ~~AFT~~ END OF GROOVE.

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ✓ Yes ____ No   Clarification Form Page No.(s): C-15A

Thiokol CORPORATION
SPACE OPERATIONS

2:30

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: 360T028 | **Side:** ☑ Left (A) ☐ Right (B) | **Date:** 1-8-93

Assessment Engineer(s)/Inspector(s): WILKES / MILLER

Nozzle Subassembly: AFT EXIT CONE ASSEMBLY

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface: Distance From Fwd	Location on Bonding Surface: Distance From Aft
184	1.90	.90	6.40	
183	.70	.60	11.60	
180	.80	.60	15.10	
179	.80	.40	25.40	
89	1.70	.70	27.60	
356	2.90	1.00	8.80	
250	.90	.60	23.50	

Notes / Comments TYPICALLY VERY FEW SMALL ADHESIVE VOIDS (.500 DIA MAX) WERE OBSERVED AROUND CIRCUMFERENCE.

Corresponding Comment Number(s): /

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-12
Nozzle Subassembly Phenolic Bondline Condition

Motor No.: 360T028	Side: Left (A)	Date: 12/15/92
Assessment Engineer(s)/Inspector(s): J. WALKER P. MILLER		
Phenolic Subassembly: Forward Exit Cone Assembly		

Record Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

Degree Location

	0-90	90-180	180-270	270-360				
Metal-to-Adhesive	10	15	10	10				
Within Adhesive	15	15	15	15				
Adhesive-to-GCP	75	70	75	75				
Within GCP								
GCP-to-CCP								
Within CCP								

Record Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

Degree Location

Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-GCP								

Phenolic Removal Method: ______

Metal Housing Bondline Surface Observations:

	Yes	No	Comment #
A. Soot?		X	
B. Voids in Adhesive?	X		1
C. Corrosion?	X		2
D. Foreign Material?		X	

Notes / Comments

1) VOIDS DOCUMENTED ON CLARIFICATION FORM C-16A
2) MEDIUM-TO-HEAVY CORROSION ON AREAS OF METAL-TO-ADHESIVE SEPARATION

Preliminary PFAR(s)? ____ Yes __X__ No Preliminary PFAR Number(s): ______

Clarification Form(s)? __X__ Yes ____ No Clarification Form Page No.(s): C-16A

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: 360T028	Side: ☒ Left (A) ☐ Right (B)	Date: 12/15/92
Assessment Engineer(s)/Inspector(s): J. WALKER P. MILLER		
Nozzle Subassembly: FORWARD EXIT CONE		

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface: Distance From Fwd	Location on Bonding Surface: Distance From Aft
17°	.8"	.4"		7.7"
45°	.5"	.3"		10.5"
58°	.7"	.4"		2.7"
77°	1.6"	.5"		12.9"
76°	1.0"	.4"		19.2"
76°	1.1"	.5"		22.9"
98°	1.1"	.5"		8.7"
159°	.5"	.3"		4.3"
352°	.9"	.5"		6.9"
355°	.1"	.8"		8.1"

Notes / Comments

Corresponding Comment Number(s): 1

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-12
Nozzle Subassembly Phenolic Bondline Condition

Motor No.: 360T028	Side: Left (A)	Date: 12/16/92

Assessment Engineer(s)/Inspector(s): J. WALKER P. MILLER

Phenolic Subassembly: Throat Assembly

Record Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

Degree Location

	0-45	45-90	90-135	135-180	180-225	225-270	270-315	315-360
Metal-to-Adhesive	100	100	95	95	100	100	97	100
Within Adhesive								
Adhesive-to-GCP			5	5			3	
Within GCP								
GCP-to-CCP								
Within CCP								

Record Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

Degree Location

Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-GCP								

Phenolic Removal Method: __________

Metal Housing Bondline Surface Observations:

	Yes	No	Comment #
A. Soot?		✓	
B. Voids in Adhesive?	✓		2
C. Corrosion?	✓		1
D. Foreign Material?		✓	

Notes / Comments

1) MEDIUM-TO-HEAVY CORROSION 360° EXCEPT @ ADHESIVE-TO-GCP BONDLINE FAILURE LOCATION.

2) SEE PAGE C-17A

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ✓ Yes ____ No   Clarification Form Page No.(s): C-17A

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: 360T028 | Side: ☒ Left (A) ☐ Right (B) | Date: 12/16/92

Assessment Engineer(s)/Inspector(s): J. WALKER P. MILLER

Nozzle Subassembly: THROAT ASSEMBLY

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface Distance From Fwd	Location on Bonding Surface Distance From Aft
228°	.20"	1.90"		.10"
235°	1.10"	.4"		.10"

Notes / Comments

Corresponding Comment Number(s): 2

REVISION ___

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-12
Nozzle Subassembly Phenolic Bondline Condition

Motor No.: 360T028 | Side: Left (A) | Date: 1-18-93

Assessment Engineer(s)/Inspector(s): WILKES / DIEHL

Phenolic Subassembly: Aft Inlet/Forward Nose Rings

Record Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

Degree Location

	45-135	135-225	225-315	315-45				
Metal-to-Adhesive	100	95	100	100				
Within Adhesive								
Adhesive-to-GCP		5						
Within GCP								
GCP-to-CCP								
Within CCP								

Record Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

NA

Degree Location

Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-GCP								

Phenolic Removal Method: HAMMER & WEDGE

Metal Housing Bondline Surface Observations:	Yes	No	Comment #
A. Soot?		✓	
B. Voids in Adhesive?	✓		1
C. Corrosion?	✓		2
D. Foreign Material?	✓		3

Notes / Comments (1) SEE PFOR CLARIFICATION FORM PAGE C-18A & NOTE 1.
(2) TYPICAL MEDIUM TO HEAVY CORROSION OVER 98% OF BONDLINE AREA.
(3) A BROWNISH CLEAR TACKEY FOREIGN MATERIAL WAS OBSERVED IN AN ADHESIVE VOID ON THE FWD NOSE RING INTERFACE. SEE PFOR CLARIFICATION FORM PAGE C-18A FOR SIZE & LOCATION OF VOID. A PRELIMINARY PFAR WAS WRITTEN ON THIS CONDITION.

Preliminary PFAR(s)? ✓ Yes ___ No   Preliminary PFAR Number(s): 53C-11

Clarification Form(s)? ✓ Yes ___ No   Clarification Form Page No.(s): C-18A

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: 360T028 | Side: ☑ Left (A) ☐ Right (B) | Date: 1-18-93

Assessment Engineer(s)/Inspector(s): WILKES / DIEHL

Nozzle Subassembly: NOSE INLET & AFT INLET RINGS

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface Distance From Fwd	Location on Bonding Surface Distance From Aft
271°	.50	.30	1.50	
252°	.38	.20	.40	
344°	.25	.25	1.80 (SEE NOTE 2)	

Notes / Comments ① TYPICAL SMALL ADHESIVE VOIDS, 0.30 IN DIA MAXIMUM, WERE OBSERVED THROUGHOUT BONDLINE.

② FOREIGN MATERIAL FILLED THE ADHESIVE VOID AT 344°. THE METAL HOUSING AT THIS LOCATION SHOWED NO CORROSION. SAMPLES WERE TAKEN FROM PHENOLICS AND METAL SURFACES AND SENT TO LAB FOR ANALYSIS.

Corresponding Comment Number(s): 1

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-12
Nozzle Subassembly Phenolic Bondline Condition

Motor No.: 360T028	Side: Left (A)	Date: 1-18-93

Assessment Engineer(s)/Inspector(s): WILKES / DIEHL

Phenolic Subassembly: Nose Cap

Record Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

Degree Location

	0-360							
Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-GCP								
Within GCP	5							
GCP-to-CCP	95							
Within CCP								

Record Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

Degree Location

	0-45	45-90	90-135	135-180	180-225	225-270	270-315	315-360
Metal-to-Adhesive	34	15	29	15	29	18	60	16
Within Adhesive	1		1		1		1	
Adhesive-to-GCP	65	85	70	85	70	82	39	84

Phenolic Removal Method: HAMMER, WEDGE & PEEL

Metal Housing Bondline Surface Observations:	Yes	No	Comment #
A. Soot?		✓	
B. Voids in Adhesive?	✓		1
C. Corrosion?	✓		3
D. Foreign Material?		✓	

Notes / Comments ① SEE PFOR CLARIFICATION FORM PAGE C-19A & NOTE 1.
② Special Issues 3.3.5 and 3.3.6: SEE CLARIFICATION FORM PAGE C-19A NOTE 2
③ TYPICAL LIGHT-TO-MEDIUM CORROSION ON FORWARD 1.0 IN. MAXIMUM INTERMITTENTLY AROUND 75% CIRCUM. AND AFT 3.25 IN. MAX FULL CIRCUM.

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ✓ Yes ____ No   Clarification Form Page No.(s): C-19A

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: 360T028 | Side: ☑ Left (A) ☐ Right (B) | Date: 1-18-93

Assessment Engineer(s)/Inspector(s): WILKES / DIEHL

Nozzle Subassembly: NOSE CAP

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface: Distance From Fwd	Distance From Aft
			METAL-TO-AFT	
230	.32	.22	1.40	
340	.35	.25	13.80	
			METAL-TO-FWD	
* 0°	.32	.35	1.05	
* 81°	.28	.18	1.10	
*295°	.35	.200	1.20	

* NOSE CAP-TO-FWD NOSE RING INTERFACE.

Notes / Comments ① TYPICAL SMALL ADHESIVE VOIDS, 0.30 IN. DIA. MAX, WERE OBSERVED THROUGHT BONDLINE.

② ADHESIVE VOIDS OBSERVED AT 0°, 81° & 295° ARE NEAR LDA's IN DR-407578 AT 0°, 81° AND 300°. THE SIZES DO NOT CORRELATE VERY WELL BUT VOIDS WERE AT CHAR LINE AND MAY HAVE EXTENDED FORWARD BUT EVIDENCE WAS BURNED OFF.
THE LDI IN DR-410530 WAS IN THE CHAR & EROSION AREA THEREFORE EVIDENCE WAS BURNED OFF.

Corresponding Comment Number(s): 1 & 2

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-12
Nozzle Subassembly Phenolic Bondline Condition

Motor No.: 360T028 | Side: Left (A) | Date: 12-18-92

Assessment Engineer(s)/Inspector(s): M. Clark, T. Freston

Phenolic Subassembly: Cowl Assembly

Record Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

Degree Location

	315-45	45-135	135-225	225-315				
Metal-to-Adhesive	100	100	100	100				
Within Adhesive								
Adhesive-to-SCP								
Within SCP								
SCP-to-CCP								
Within CCP								

Record Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

Degree Location

	N/A							
Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-SCP								

Phenolic Removal Method: ______

Metal Housing Bondline Surface Observations:

	Yes	No	Comment #
A. Soot?		✓	
B. Voids in Adhesive?	✓		1
C. Corrosion?	✓		2
D. Foreign Material?		✓	

Notes / Comments

1) Special Issue 3.3.8: 3 of 5 LDIs were found Reference page C-20A for Void locations.

2) Medium-to-heavy corrosion bonding surface

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ✓ Yes ______ No   Clarification Form Page No.(s): C-20A

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: 360T028	Side: [X] Left (A) [ ] Right (B)	Date: 12-18-92
Assessment Engineer(s)/Inspector(s): M. Clark, T. Freston		
Nozzle Subassembly: Cowl		

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface Distance From Fwd	Location on Bonding Surface Distance From Aft
* 240	2.2	foward 3.55, center 0.32	0	
* 248	0.96	3.1	0	
* 220	0.62	2.45	0	

Notes / Comments
*1) Void match LDI that were detected by X-ray

Corresponding Comment Number(s): ____

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-12
Nozzle Subassembly Phenolic Bondline Condition

Motor No.: 360T028	Side: Left (A)	Date: 12-17-92
Assessment Engineer(s)/Inspector(s): M. Clark, J. Passman, T. Freston		
Phenolic Subassembly: Fixed Housing Assembly		

Record Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

Degree Location

	315-45	45-135	135-225	225-315			total
Metal-to-Adhesive	70	25	20	40			39
Within Adhesive							
Adhesive-to-GCP	10	40	78	30			40
Within GCP	20	35	2	30			21
GCP-to-CCP							
Within CCP							

Metal-to-adhesive separation exceeds 15%
A preliminary PFAR was written.

Record Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

Degree Location

	315-45	45-135	135-225	225-315			
Metal-to-Adhesive		5		5			3
Within Adhesive							
Adhesive-to-GCP	100	95	100	95			97

Phenolic Removal Method: ______________________

Metal Housing Bondline Surface Observations:	Yes	No	Comment #
A. Soot?		✓	
B. Voids in Adhesive?	✓		1
C. Corrosion?		✓	
D. Foreign Material?		✓	

Notes / Comments
1) Voids documented on C-21A
2) A dark line was stained on the housing. Reference page C-21B and C-21C
3) 4 indications were found by ultrasonics and 2 were found during bondline assessment. Reference C-21D

Preliminary PFAR(s)? ✓ Yes ____ No Preliminary PFAR Number(s): SSC-06

Clarification Form(s)? ✓ Yes ____ No Clarification Form Page No.(s): C-21A, B, C & D

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: 360T028	Side: ☑ Left (A) ☐ Right (B)	Date: 12/17/92

Assessment Engineer(s)/Inspector(s): JIM PASSMAN, MARK CLARK, TREVOR FRKSTON

Nozzle Subassembly: FIXED HOUSING

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface Distance From Fwd	Location on Bonding Surface Distance From Aft
32°	.575	.30	—	.70
110°	.95	.30	—	1.80
128°	.65	.15	10.8	—
130°	1.95	.65	10.5	—
142°	.55	.30	—	2.3
170°	.75	.20	—	5.5
220°	.95	.35	—	1.9
282	.75	.25	—	2.2
345	.65	.30	—	.20

Notes / Comments

INTERMITTENT SMALL VOIDS ~ .30 CIRC x .20 AXIAL.

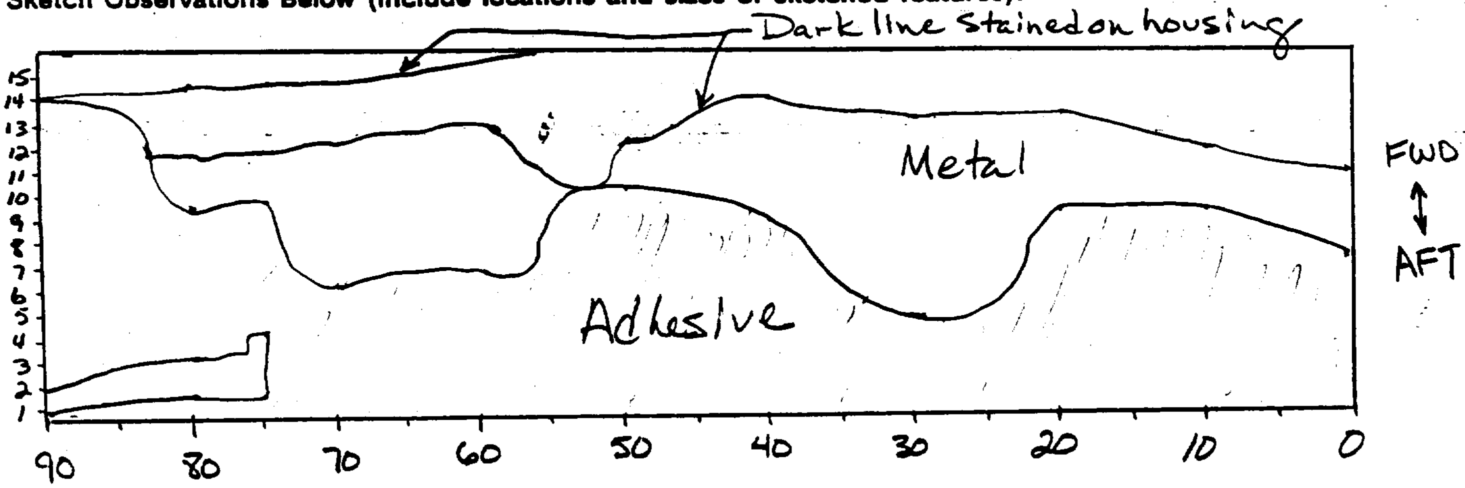
Corresponding Comment Number(s): 1

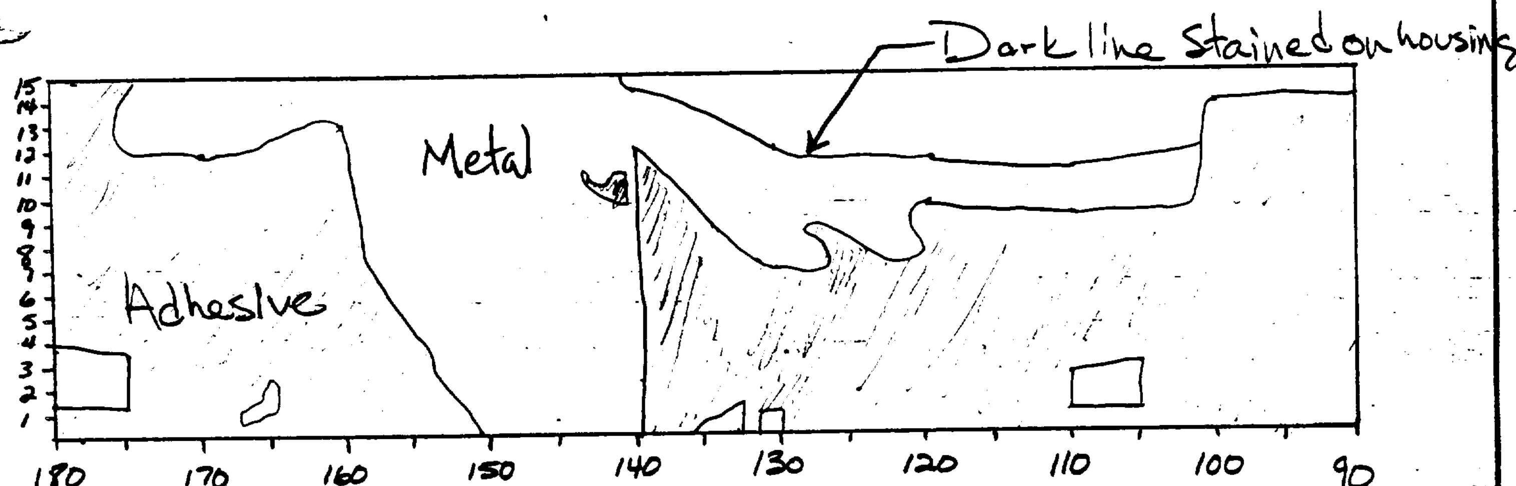
Thiokol CORPORATION
SPACE OPERATIONS

General Hardware Clarification Form

Motor No.: 360T028	Side: ☒ Left (A) ☐ Right (B)	Date: 12-17-92
Assessment Engineer(s)/Inspector(s): M. Clark, J. Passman, T. Freston		
Description: Fixed Housing Bondline Map, Metal side		

Sketch Observations Below (include locations and sizes of sketched features):





Corresponding Comment Number(s): ______

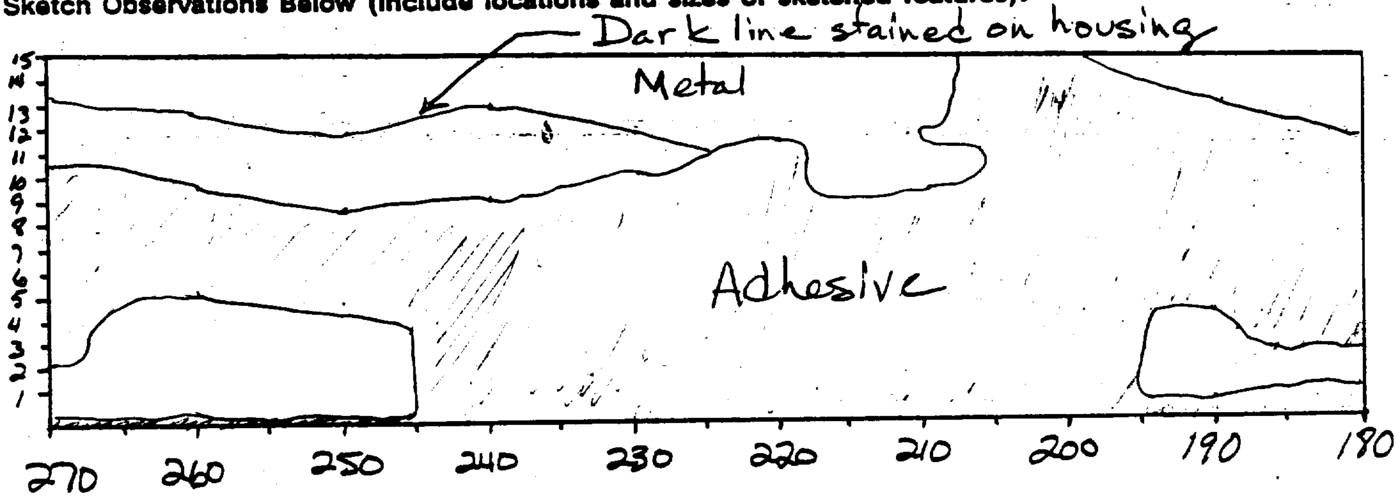
REVISION ___

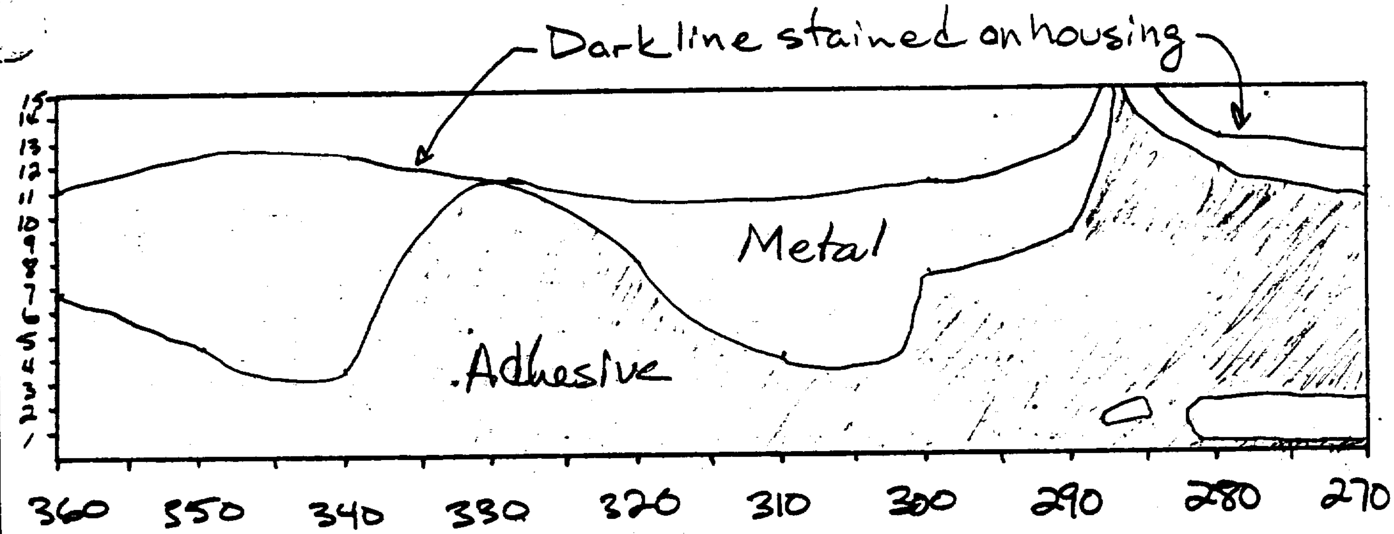
Thiokol CORPORATION
SPACE OPERATIONS

General Hardware Clarification Form

Motor No.: 360T028	Side: ☒ Left (A) ☐ Right (B)	Date: 12-17-92
Assessment Engineer(s)/Inspector(s): M.E. Clark, J. Passman, T. Freston		
Description: Fixed Housing Bondline Map		

Sketch Observations Below (include locations and sizes of sketched features):





Corresponding Comment Number(s): __________

Thiokol CORPORATION
SPACE OPERATIONS

General Hardware Clarification Form

Motor No.: 360T028	Side: ☒ Left (A) ☐ Right (B)	Date: 12-17-92

Assessment Engineer(s)/Inspector(s): M. E. Clark, J. Passman, P. Miller

Description: Ultrasonic Indications vs. Bondline Condition.

Sketch Observations Below (include locations and sizes of sketched features):

Ultrasonic Indications	Bondline Condition
① 75° - 95° 5.5" - 6.25" aft of fwd end	① Unbond area found with an axial width of 1". Area defined by a dark line stained on the housing.
② 74° - 88° 14.5" - 15.5" aft of fwd end	② No unbond found
③ 100° - 115° 5.5" - 6.25" aft of fwd end	③ Area lost during water blasting
④ 130° 11.0" aft of fwd end 1.5" axial x 1.0 circ.	④ An adhesive void was found 10.5" aft of the fwd end at 130° The void measured 1.95" axial x 0.65" circ.

Corresponding Comment Number(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-13
Cowl Ring Phenolic (CCP) Section Condition

Motor No.: 360T028	Side: Left (A)	Date: 5/18/93

Assessment Engineer(s)/Inspector(s): R. Quick

Cowl Phenolic Section Observations:

	Yes	No	Comment #
A. Cross-ply cracking in virgin material?		✓	
B. Ply lifting?		✓	

Record the Cowl Char and Erosion Measurements Below:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
0.3	.30	.65	.27	.62	.30	.50	.28	.52
1.0	.36	.63	.29	.64	.35	.51	.31	.55
2.0	.40	.64	.28	.67	.35	.59	.33	.64
3.0	.43	.53	.31	.68	.32	.65	.35	.65
4.0	.44	.55	.31	.63	.32	.66	.35	.66
5.0	.38	.62	.29	.67	.30	.68	.33	.69
6.0	.30	.68	.22	.80	.24	.75	.25	.80
6.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Negative Margin of Safety? ______ Yes ✓ No Station: ______ Degree: ______

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-14
Forward Exit Cone Phenolic (CCP) Section Condition

Motor No.: 360T028	Side: Left (A)	Date: 5/18/93
Assessment Engineer(s)/Inspector(s): R.Quick		

Forward Exit Cone Phenolic Section Observations:

	Yes	No	Comment #
A. Cross-ply cracking in virgin material?		✓	
B. Ply lifting?		✓	

Record the Forward Exit Cone Char and Erosion Measurements Below:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
1.0	.37	.80	.34	.77	.35	.74	.34	.80
4.0	.38	.74	.34	.75	.33	.76	.34	.80
4.6	.36	.74	.34	.76	.35	.73	.34	.80
8.0								
12.0								
16.0								
20.0								
24.0								
28.0								
32.0								
32.9								
34.0								

Negative Margin of Safety? ____ Yes ✓ No Station: ____ Degree: ____

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-15
Fixed Housing Phenolic (CCP) Section Condition

Motor No.: 360T028	Side: Left (A)	Date: 5/18/93

Assessment Engineer(s)/Inspector(s): R. Quick

Fixed Housing Phenolic Section Observations:

	Yes	No	Comment #
A. Cross-ply cracking in virgin material?		✓	
B. Ply lifting?		✓	

Record the Fixed Housing Char and Erosion Measurements Below:

Station	0°		90°		180°		270°	
Location	Erosion	Char	Erosion	Char	Erosion	Char	Erosion	Char
0.0	.04	1.13	.06	1.00	0	1.12	.04	1.28
1.0	.02	1.06	.04	.99	.04	.95	.05	1.01
2.0	.03	.93	0	.88	.02	.91	.06	1.01
3.0	.02	.94	0	.87	.03	.89	.03	1.00
4.0	.04	.88	0	.90	0	.91	.03	.94
5.0	.03	.87	0	.93	0	.89	.02	.93
6.0	0	.87	0	.85	0	.85	0	.90
7.0	0	.88	0	.85	0	.86	0	.88
8.0	0	.81	0	.77	0	.75	0	.73
9.0	0	.72	N/A	N/A	0	.68	0	.64
10.75	0	1.84	N/A	N/A	N/A	N/A	.18	1.46

Negative Margin of Safety? _____ Yes ✓ No Station: _____ Degree: _____

Notes / Comments

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Clarification Form Page No.(s): _____

POSTFLIGHT OBSERVATION RECORD (PFOR) C-16
Throat Inlet Assembly Phenolic (CCP) Section Condition

Motor No.: 360T028	Side: Left (A)	Date: 5/19/93
Assessment Engineer(s)/Inspector(s): R. Quick		

Throat Inlet Assembly Phenolic Section Observations:

	Yes	No	Comment #
A. Cross-ply cracking in virgin material?		✓	
B. Ply lifting?		✓	

Record the Throat Inlet Ring and Throat Ring Char and Erosion Measurements Below:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
1.0	1.04	.54	1.01	.47	1.02	.47	1.05	.47
2.0	1.15	.53	1.03	.52	1.05	.48	1.05	.49
4.0	1.12	.50	1.09	.54	1.11	.46	1.12	.52
6.0	1.17	.51	1.13	.56	1.12	.52	1.16	.55
8.0	1.21	.50	1.21	.48	1.17	.46	1.20	.58
10.0	1.22	.41	1.18	.47	1.17	.40	1.18	.44
12.0	1.19	.37	1.12	.44	1.17	.36	1.17	.47
14.0	1.16	.47	1.13	.42	1.14	.37	1.13	.47
16.0	1.08	.55	1.07	.42	1.09	.44	1.08	.49
18.0	1.07	.58	.93	.52	.92	.59	.93	.51
20.0	.78	.61	.73	.55	.68	.64	.85	.56
22.0	.51	.62	.48	.62	.44	.67	.53	.56
23.0	.39	.69	.40	.71	.36	.73	.39	.70

Negative Margin of Safety? ______ Yes ✓ No Station: ______ Degree: ______

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-17
Nose Cap Phenolic (CCP) Section Condition

Motor No.: 360T028	Side: Left (A)	Date: 5/20/93
Assessment Engineer(s)/Inspector(s): R. QUICK		

Nose Cap Phenolic Section Observations:

	Yes	No	Comment #
A. Cross-ply cracking in virgin material?		✓	
B. Ply lifting?		✓	

Record the Nose Cap Char and Erosion Measurements Below:

Station	0°		90°		180°		270°	
Location	Erosion	Char	Erosion	Char	Erosion	Char	Erosion	Char
1.5	N/A	N/A	.29	.62	.31	.62	.31	.60
4.0	.41	.58	.36	.52	.36	.55	.41	.55
6.0	.47	.54	.40	.57	.39	.53	.43	.54
8.0	.52	.49	.46	.54	.47	.48	.48	.50
10.0	.57	.52	.48	56	.48	.47	.54	.48
12.0	.59	.52	.54	.50	.58	.43	.59	.46
14.0	.71	.47	.59	.47	.62	.44	.59	.52
16.0	.79	.48	.67	.48	.71	.39	.74	.42
18.0	.90	.46	.78	.46	.78	.42	.85	.46
20.0	1.13	.50	.97	.42	.96	.41	1.06	.46
22.0	1.79	.68	1.49	.61	1.39	.69	1.55	.67
24.0	1.97	.68	1.73	.67	1.63	.67	1.75	.71
26.0	1.42	.74	1.21	.70	1.10	.73	1.23	.74

Negative Margin of Safety? ____ Yes ✓ No Station: ____ Degree: ____

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-18

Forward Nose Ring and Aft Inlet Ring Phenolic (CCP) Section Condition

Motor No.: 360T028	Side: Left (A)	Date: 5/20/93
Assessment Engineer(s)/Inspector(s): R. Quick		

Forward Nose and Aft Inlet Ring Phenolic Section Observations:

	Yes	No	Comment #
A. Cross-ply cracking in virgin material?		✓	
B. Ply lifting?		✓	

Record the Forward Nose Ring (-503) Char and Erosion Measurements Below:

Station	0°		90°		180°		270°	
Location	Erosion	Char	Erosion	Char	Erosion	Char	Erosion	Char
28.0	1.27	.69	1.11	.63	1.07	.69	1.12	.66
30.0	.99	.71	.91	.71	.90	.69	.97	.69
32.0	.91	.64	.91	.55	.93	.63	.95	.63

Negative Margin of Safety? ______ Yes ______ No Station: ______ Degree: ______

Record the Aft Inlet Ring Char (-504) and Erosion Measurements Below:

Station	0°		90°		180°		270°	
Location	Erosion	Char	Erosion	Char	Erosion	Char	Erosion	Char
34.0	.88	.55	.87	.60	.84	.55	.88	.56
36.0	.91	.60	.89	.63	.86	.58	.92	.60
38.0	1.03	.56	.99	.59	.93	.58	1.02	.65
39.0	1.05	.60	1.02	.61	.97	.61	1.08	.65

Negative Margin of Safety? ______ Yes ✓ No Station: ______ Degree: ______

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

POSTFLIGHT OBSERVATION RECORD (PFOR) C-1

Nozzle Assembly Quick-look Condition

Motor No.: 360L028	Side: ☐ Left (A) ☒ Right (B)	Date: 12-14-92	
Assessment Engineer(s)/Inspector(s): M.E. CLARK			

Nozzle Assembly Quick-look Observations:

	Yes	No	Comment #
A. Metal Damage Due to Transportation or Handling?		✓	
B. Phenolic Damage Due to Transportation or Handling?	✓		1
C. Foreign Material?		✓	

Notes / Comments

1) Very minor damage to small portion of FEC phenolic that remains on aft end. No erosion and char measurements will be taken in these areas. Tie-down chains rubbed through covering.

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ________

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-2
Internal Nozzle Joint Condition

Motor No.: 360T028	Side: Right (B)	Date: 12/15/92
Assessment Engineer(s)/Inspector(s): J. WALKER P. MILLER		
Joint: Nose Inlet-to-Flex Bearing-to-Cowl (Joint #2)		

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Gas Penetration in the RTV (Terminated, Through)?		X	
B. RTV Not Below Char Line?		X	
C. RTV To the Primary O-ring?		X	
D. RTV Past the Primary O-ring?		X	
E. Uncured RTV?		X	
F. Voids Within RTV?		X	
G. Foreign Material?		X	
H. Heat Affected or Eroded Virgin CCP, GCP/SCP, or adhesive?		X	
I. Damaged Phenolics?		X	
J. Bondline Edge Separations? Use Clarification Form.		X	
K. Phenolics Axially Displaced From Housing?		X	
L. Heat Affected Metal?		X	
M. Unbonded or Blistered Paint?	X		2
N. Corrosion?	X		1
O. Excessive Grease in Threaded Bolt Holes?		X	
P. Bolt Hole Damage (Through, Threaded/Helical Coil Insert)?		X	
Q. Bent or Broken Bolts?		X	
R. Metal Damage (Joints or Housings)?		X	

Notes / Comments

1) CORROSION PRESENT & NOTED ON PAGE C-30

2) INTERMITTENT BUBBLED PAINT ON FLEX BEARING FORWARD END RING O.D. AT VARIOUS AXIAL POSITIONS AROUND FULL CIRCUMFERENCE. MORE NUMEROUS AND SMALLER BUBBLES PRESENT ON FORWARD MOST REGION Bubbles present at 5°-to-95°. A preliminary PFAR was written.

Preliminary PFAR(s)? ✓ Yes ____ No Preliminary PFAR Number(s): 53C-03

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

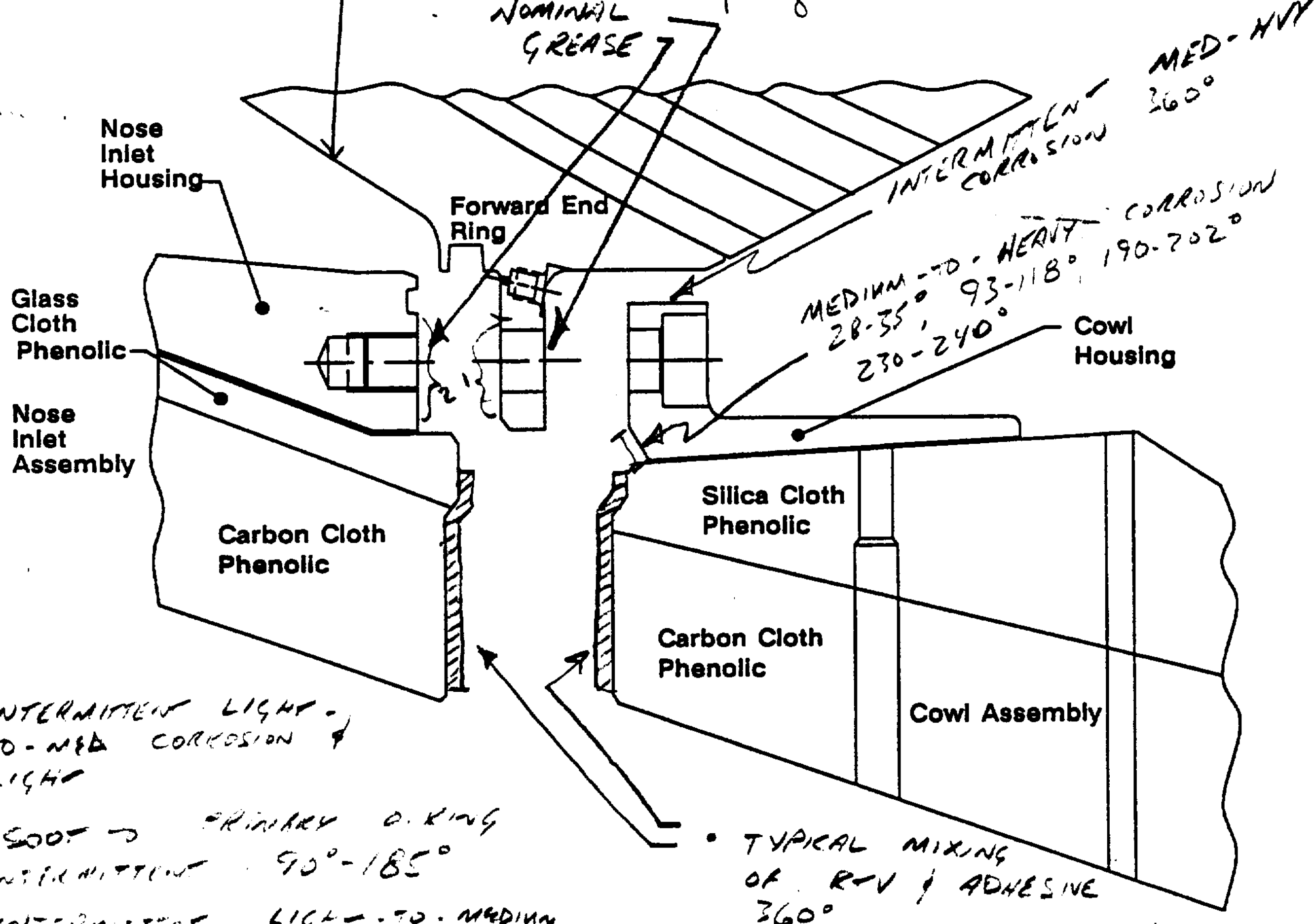
POSTFLIGHT OBSERVATION RECORD (PFOR) C-3

Nose Inlet-to-Flex Bearing-to-Cowl Joint (Joint #2) Condition Drawing Worksheet

Motor No.: 360T028	Side: Right (B)	Date: 12/15/92
Assessment Engineer(s)/Inspector(s):	J. Walker, P. Miller, M. Clark	

Sketch Observations Below (include locations and sizes of sketched features):

Intermittent bubbled paint at 5°-180°
0.10" max. diameter Both top coat and primer bubbled. No corrosion on surface below bubbles or sign of heat affects
A clear fluid was found in the bubbles. A sample was taken with a syringe.



1) INTERMITTENT LIGHT-TO-MED CORROSION & LIGHT

2) • SOOT TO PRIMARY O-RING INTERMITTENT 90°-185°
• INTERMITTENT LIGHT-TO-MEDIUM CORROSION 360°

• TYPICAL MIXING OF R-V & ADHESIVE 360°
• HEAVY SOOTING 45°-210°
• LIGHT-TO-MEDIUM SOOTING 210-0-45°

ORIGINAL PAGE IS OF POOR QUALITY

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-2
Internal Nozzle Joint Condition

Motor No.: 360T028	Side: Right (B)	Date: 12-16-92

Assessment Engineer(s)/Inspector(s): M. E. Clark, P. Miller

Joint: Nose Inlet-to-Throat (Joint #3)

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Gas Penetration in the RTV (Terminated, Through)?		✓	
B. RTV Not Below Char Line?		✓	
C. RTV To the Primary O-ring?		✓	
D. RTV Past the Primary O-ring?		✓	
E. Uncured RTV?		✓	
F. Voids Within RTV?		✓	
G. Grease Inhibiting RTV Backfill?		✓	
H. Foreign Material?		✓	
I. Heat Affected or Eroded Virgin CCP, GCP/SCP, or adhesive?		✓	
J. Damaged Phenolics?		✓	
K. Bondline Edge Separations? Use Clarification Form.	✓		1
L. Phenolics Axially Displaced From Housing?		✓	
M. Heat Affected Metal?		✓	
N. Unbonded or Blistered Paint?	✓		2
O. Corrosion?	✓		3
P. Alignment Pin Damage?		✓	
Q. Excessive Grease in Threaded Bolt Holes?		✓	
R. Bolt Hole Damage (Through, Threaded/Helical Coil Insert)?		✓	
S. Bent or Broken Bolts?		✓	
T. Metal Damage (Joints or Housings)?		✓	

Notes / Comments

1) Separations documented on page C-31A
2) Bubbled paint observed on O.D. surface of throat flange. Reference C-32. A preliminary PFAR was written.
3) Corrosion observed. Reference page C-32.

Preliminary PFAR(s)? ✓ Yes ____ No Preliminary PFAR Number(s): 53C-05

Clarification Form(s)? ✓ Yes ____ No Clarification Form Page No.(s): C-31A

REVISION ____

C-3

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Interface Separation Clarification Form

Motor No.: 360T028	Side: ☐ Left (A) ☒ Right (B)	Date: 12-16-92
Assessment Engineer(s)/Inspector(s): M.E. Clark		

Part:
- ☐ Forward Exit Cone (Forward End)
- ☐ Throat Ring (Aft End)
- ☒ Throat Inlet Ring (Forward End)
- ☐ Aft Inlet Ring (Aft End)
- ☐ Nose Cap (Aft End)
- ☐ Cowl (Forward End)*
- ☐ Inner Boot Ring (Forward End)

Interface Separation Types:

A. Metal-to-Adhesive
B. Within Adhesive
C. Adhesive-to-GCP
D. Within GCP
E. GCP-to-CCP
F. Within CCP
*G. Adhesive-to-SCP
*H. Within SCP
*I. SCP-to-CCP

Circumferential Location	Separation Type	Maximum Radial Width
0-360	A	0.015

Corresponding Comment Number(s): ______

REVISION ___

DOC NO. TWR-64216 VOL
SEC PAGE C-31a

POSTFLIGHT OBSERVATION RECORD (PFOR) C-4

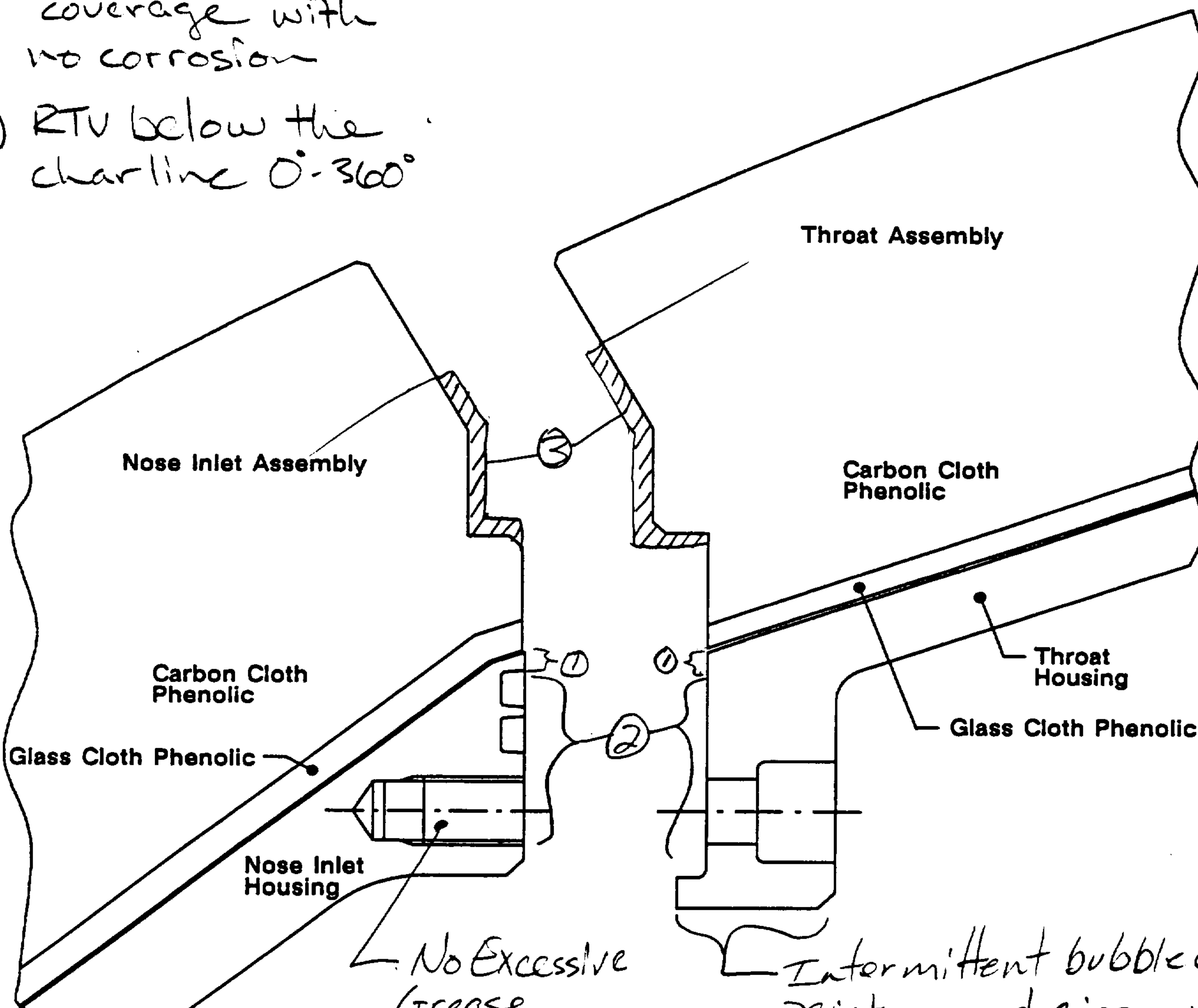
Nose Inlet-to-Throat Joint (Joint #3) Condition Drawing Worksheet

Motor No.: 360T028	Side: Right (B)	Date: 12-16-92
Assessment Engineer(s)/Inspector(s): M.E. Clark, P. Miller		

Sketch Observations Below (include locations and sizes of sketched features):

2) Nominal grease coverage with no corrosion

3) RTV below the charline 0°-360°



Intermittent bubbled paint around circ. with a max. dia. of 0.05" No Fluid in bubbles, corrosion or sign of heat affects observed.

1) Intermittent Light-to-medium corrosion around the circ.

Clarification Form(s)? ______ Yes __✓__ No Clarification Form Page No.(s): ______________

REVISION ____

POSTFLIGHT OBSERVATION RECORD (PFOR) C-2

Internal Nozzle Joint Condition

Motor No.: 360L028 | Side: ☐ Left (A) ☒ Right (B) | Date: 12-15-92

Assessment Engineer(s)/Inspector(s): M.E. Clark

Joint: ☐ Nose Inlet-to-Flex Bearing-to-Cowl (Joint #2) ☒ Throat-to-Forward Exit Cone (Joint #4)
☐ Nose Inlet-to-Throat (Joint #3) ☐ Aft End Ring-to-Fixed Housing (Joint #5)

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Gas Penetration in the RTV (Terminated, Through)?		✓	
B. RTV Not Below Char Line?		✓	
C. RTV To the Primary O-ring?	✓		1
D. RTV Past the Primary O-ring?		✓	
E. Uncured RTV?		✓	
F. Voids Within RTV?		✓	
G. Grease Inhibiting RTV Backfill (Joints 3 and 4)?		✓	
H. Foreign Material?		✓	
I. Heat Affected or Eroded Virgin CCP, GCP/SCP, or adhesive?		✓	
J. Damaged Phenolics?		✓	
K. Bondline Edge Separations? Use Clarification Form.	✓		2
L. Phenolics Axially Displaced From Housing?		✓	
M. Heat Affected Metal?		✓	
N. Unbonded or Blistered Paint?		✓	
O. Corrosion?	✓		3
P. Alignment Pin Damage (Joints 3, 4, and 5)?		✓	
Q. Excessive Grease in Threaded Bolt Holes?		✓	
R. Bolt Hole Damage (Through, Threaded/Helical Coil Insert)?		✓	
S. Bent or Broken Bolts?		✓	
T. Metal Damage (Joints or Housings)?		✓	

Notes / Comments

1) RTV reached the primary o-ring at 105° - 362.5°
2) Separations documented on pages C-33A and C-33B
3) Light-to-medium corrosion observed. Reference page C-34 for locations.

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ✓ Yes ______ No Clarification Form Page No.(s): C-33A & C-33B

Nozzle Interface Separation Clarification Form

Motor No.: 360L028 | Side: ☐ Left (A) ☒ Right (B) | Date: 12-15-92

Assessment Engineer(s)/Inspector(s): M.E. Clark

Part:
- ☒ Forward Exit Cone (Forward End)
- ☐ Throat Ring (Aft End)
- ☐ Throat Inlet Ring (Forward End)
- ☐ Aft Inlet Ring (Aft End)
- ☐ Nose Cap (Aft End)
- ☐ Cowl (Forward End)*
- ☐ Inner Boot Ring (Forward End)

Interface Separation Types:

A. Metal-to-Adhesive
B. Within Adhesive
C. Adhesive-to-GCP
D. Within GCP
E. GCP-to-CCP
F. Within CCP
*G. Adhesive-to-SCP
*H. Within SCP
*I. SCP-to-CCP

Circumferential Location	Separation Type	Maximum Radial Width
200-310	A	0.040"

Corresponding Comment Number(s): ________

Nozzle Interface Separation Clarification Form

Motor No.: 360L028	Side: ☐ Left (A) ☒ Right (B)	Date: 12-15-92
Assessment Engineer(s)/Inspector(s):		

Part:
- ☐ Forward Exit Cone (Forward End)
- ☒ Throat Ring (Aft End)
- ☐ Throat Inlet Ring (Forward End)
- ☐ Aft Inlet Ring (Aft End)
- ☐ Nose Cap (Aft End)
- ☐ Cowl (Forward End)*
- ☐ Inner Boot Ring (Forward End)

Interface Separation Types:

A. Metal-to-Adhesive
B. Within Adhesive
C. Adhesive-to-GCP
D. Within GCP
E. GCP-to-CCP
F. Within CCP
*G. Adhesive-to-SCP
*H. Within SCP
*I. SCP-to-CCP

Circumferential Location	Separation Type	Maximum Radial Width
0-360	A	0.010

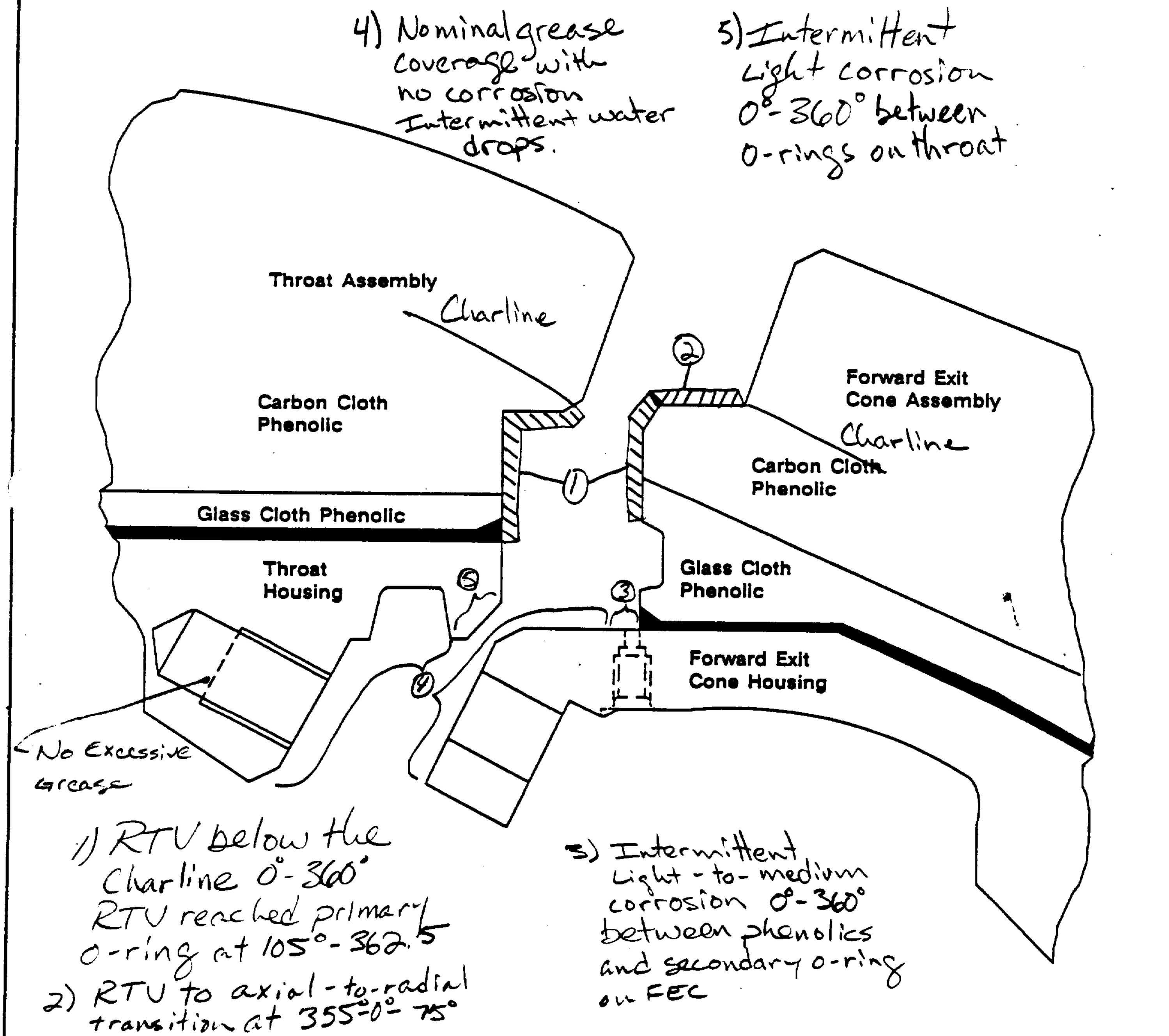
Corresponding Comment Number(s): ____

POSTFLIGHT OBSERVATION RECORD (PFOR) C-5

Throat-to-Forward Exit Cone Joint (Joint #4) Condition Drawing Worksheet

Motor No.: 360L028	Side: ☐ Left (A) ☒ Right (B)	Date: 12-15-92
Assessment Engineer(s)/Inspector(s): M.E. Clark		

Sketch Observations Below (include locations and sizes of sketched features):



Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-2
Internal Nozzle Joint Condition

Motor No.: 360T028	Side: Right (B)	Date: 12/15/92
Assessment Engineer(s)/Inspector(s): M. Clark, J. Passman		
Joint: Aft End Ring-to-Fixed Housing (Joint #5)		

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Gas Penetration in the RTV (Terminated, Through)?		✓	
B. RTV Not Below Char Line?		✓	
C. RTV To the Primary O-ring?	✓		1
D. RTV Past the Primary O-ring?		✓	
E. Uncured RTV?		✓	
F. Voids Within RTV?	✓		2
G. Foreign Material?		✓	
H. Heat Affected or Eroded Virgin CCP, GCP/SCP, or adhesive?		✓	
I. Damaged Phenolics?		✓	
J. Bondline Edge Separations? Use Clarification Form.		✓	
K. Phenolics Axially Displaced From Housing?		✓	
L. Heat Affected Metal?		✓	
M. Unbonded or Blistered Paint?		✓	
N. Corrosion?	✓		3
O. Alignment Pin Damage?		✓	
P. Excessive Grease in Threaded Bolt Holes?		✓	
Q. Bolt Hole Damage (Through, Threaded/Helical Coil Insert)?		✓	
R. Bent or Broken Bolts?		✓	
S. Metal Damage (Joints or Housings)?		✓	

Notes / Comments

1. RTV REACHED PRIMARY O-RING AT 170°-195° AND 335°-0°-8°.
2. INTERMITTENT VOIDS IN THE RTV FROM ASSEMBLY.
3. MEDIUM CORROSION ON FLEX BEARING AFT END RING; INTERMITTENT, (REFERENCE C-36).

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-6

Aft End Ring-to-Fixed Housing Joint (Joint #5) Condition Drawing Worksheet

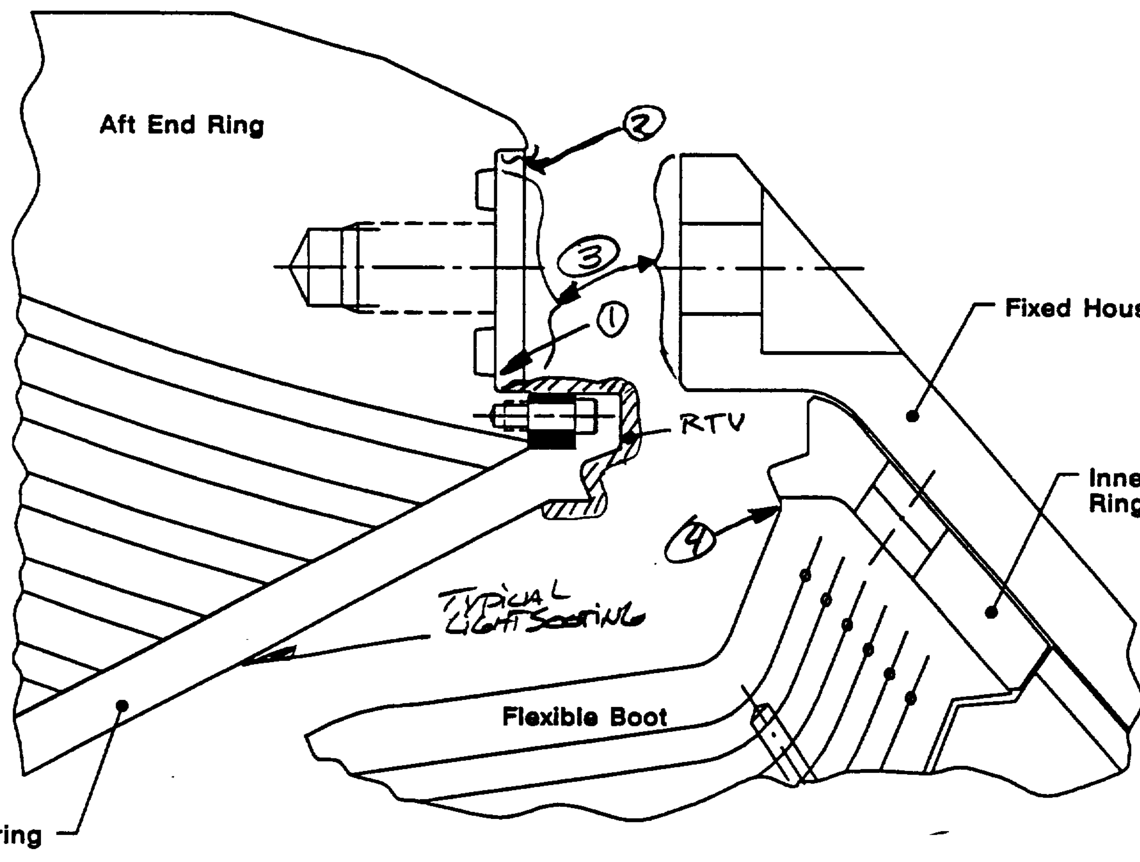
Motor No.: 360T028	Side: Right (B)	Date: 12/15/92
Assessment Engineer(s)/Inspector(s): M. Clark, J. Passman		

Sketch Observations Below (include locations and sizes of sketched features):

1 RTV NOMINAL CONDITION WITH INTERMITTENT VOIDS FROM ASSEMBLY. RTV REACHED PRIMARY FROM 170°-195° AND FROM 335°-0°-8°

2 MEDIUM CORROSION: INTERMITTENT.

4 **Special Issue 3.3.1:** NO EVIDENCE OF ABNORMAL SEPARATION OR SIGNS OF PROPAGATION



3 TYPICAL GREASE CONDITION NO CORROSION.

.rification Form(s)? ______ Yes __✓__ No   Clarification Form Page No.(s): ____________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-7
Cowl Insulation Segment Condition

Motor No.: 360T028	Side: Right (B)	Date: 12/15/92

Assessment Engineer(s)/Inspector(s): M. CLARK, J. PASSMAN, J. WALKER, P. MILLER

Cowl Insulation Segment Observations:

	Yes	No	Comment #
A. Spring Pin Holes Completely Through the Cowl Segment?		√	
B. Abnormal Heat Effects or Erosion?		√	
C. Soot Between the Cowl Segment and Cowl Housing?		√	
D. Bondline Failure Mode? Data Collection Only.	N/A	N/A	2

Notes / Comments

1) BUBBLES OBSURVED ON THE COWL SEGMENT ID SURFACE AT 195°-210° AND 355°-0° 55°.

2) BONDLINE FAILURE MODE: 5% COHESIVE WITHIN SEGMENTS
85% ADHESIVE - TO - SEGMENTS
10% ADHESIVE - TO - METAL

Preliminary PFAR(s)? ______ Yes __√__ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes __X__ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-8
Flexible Bearing, Flexible Bearing Protector, and Flexible Boot Condition

Motor No.: 360T028	Side: Right (B)	Date: 12/15/92

Assessment Engineer(s)/Inspector(s): M.E. Clark, J. Passman

Flexible Bearing, Bearing Protector, and Boot Observations:	Yes	No	Comment #
A. Bearing Protector Burn-Through?		✓	
B. Cracks Through the Bearing Protector?		✓	
C. Bearing Protector Heat Effects or Erosion Other Than at Cowl Vent Hole Locations?		✓	
D. Soot Between the Bearing Protector and Flexible Bearing?		✓	
E. Heat Effects to the Flexible Bearing?		✓	
F. Bent or Broken Bearing Protector Bolts?		✓	
G. Flexible Boot Burn-Through?		✓	
H. Abnormal Heat Effects or Erosion to Flexible Boot ID?		✓	
I. Foreign Material in Boot Cavity?		✓	

Notes / Comments

eliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

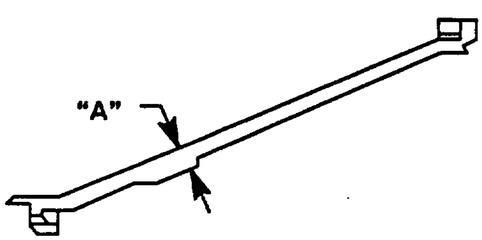
POSTFLIGHT OBSERVATION RECORD (PFOR) C-9
Flexible Bearing Protector Thickness Measurements

Motor No.: 360T028	Side: Right (B)	Date: 12-16-92

Assessment Engineer(s)/Inspector(s): Ted. Benson R.R. Gallegas

Record the Flexible Bearing Protector Gas Impingement Area Thickness Measurements (see figure) Below:

Degree Location	Thickness Measurement "A"* (inches)	Degree Location	Thickness Measurement "A"* (inches)	Degree Location	Thickness Measurement "A"* (inches)
0	.734"	120	.748"	240	.704"
10	.724"	130	.753"	250	.712"
20	.753"	140	.745"	260	.718"
30	.747"	150	.728"	270	.731"
40	.741"	160	.748"	280	.746"
50	.740"	170	.723"	290	.733"
60	.748"	180	.724"	300	.720"
70	.735"	190	.728"	310	.750"
80	.736"	200	.734"	320	.736"
90	.736"	210	.728"	330	.746"
100	.725"	220	.725"	340	.735"
110	.733"	230	.709"	350	.750"



* "A" is the minimum thickness of the bearing protector in-line with the cowl vent holes. It corresponds to the deepest gas impingement location.

Notes / Comments

NONE

Preliminary PFAR(s)? ______ Yes __✓__ No Preliminary PFAR Number(s): ____________

Clarification Form(s)? ______ Yes __✓__ No Clarification Form Page No.(s): ____________

POSTFLIGHT OBSERVATION RECORD (PFOR) C-10
Throat Diameter Measurements (Data Collection Only)

Motor No.: 360T028	Side: Right (B)	Date: 12-16-92

Assessment Engineer(s)/Inspector(s): MIGUEL ENRIQUEZ JR

Record the Nozzle Throat Diameter Measurements Below:

Degree Location	Diameter Measurement (inches)
0	55.955"
45	55.965"
90	55.930"
135	55.967

Notes / Comments

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ____________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-11
Outer Boot Ring Char and Erosion Measurements and Flexible Boot Condition

Motor No.: 360T028 | Side: Right (B) | Date: 5/20/93

Assessment Engineer(s)/Inspector(s): R. Quick

Flexible Boot/Outer Boot Ring Separation Observations:

	Yes	No	Comment #
A. Heat Effects in Boot/OBR Separation?		✓	

Record the Outer Boot Ring Char and Erosion Measurements Below:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
8.0	.01	.92	.03	.99		1.03*		1.07*
9.0	.04	.82	.02	.96	.06	.83		.91*
10.0	.03	.78	.04	.88	.04	.78	.03	.88
11.3	0	.88	.01	.90	.04	.81	.04	.98

Negative Margin of Safety? ____ Yes ✓ No Station: ____ Degree: ____

Record the Number of Plies Remaining on the Flexible Boot:

Degree Location	Plies Remaining
0	3.2
90	3.0
180	3.7
270	3.1

Negative Margin of Safety? ____ Yes ✓ No Degree: ____

Notes / Comments

* TOTAL AFFECTED DEPTH

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-12
Nozzle Subassembly Phenolic Bondline Condition

Motor No.: 360T028	**Side:** Right (B)	**Date:** 1-8-93

Assessment Engineer(s)/Inspector(s): WILKES / FRESTON

Phenolic Subassembly: Aft Exit Cone Assembly

Record Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

Degree Location

	0-360							
Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-GCP								
Within GCP	100							
GCP-to-CCP								
Within CCP								

Record Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

Degree Location

	0-45	45-90	90-135	135-180	180-225	225-270	270-315	315-0
Metal-to-Adhesive	1	4	8	15	1	5	1	3
Within Adhesive	1	2	2	4	1	2	1	1
Adhesive-to-GCP	98	94	90	81	98	93	98	96

Phenolic Removal Method: MUCH HAMMER, WEDGE & PEEL (TYPICAL)

Metal Housing Bondline Surface Observations:	Yes	No	Comment #
A. Soot?		✓	
B. Voids in Adhesive?	✓		1
C. Corrosion?		✓	
D. Foreign Material?		✓	
E. Voids in Polysulfide (Aft Exit Cone Polysulfide Groove)?	✓		2

Notes / Comments (1) SEE PFOR CLARIFICATION FORM PAGE C-42A.
(2) TYPICAL .100 DIA MAX. POLYSULFIDE VOIDS THROUGHOUT LENGTH AND CIRCUMFERENCE. POLYSULFIDE REACHED BOTTOM OF GROOVE (AFT END) AROUND FULL CIRCUMFERENCE WITH FEW INTERMITTENT VOIDS.

Preliminary PFAR(s)? ____ Yes ✓ No **Preliminary PFAR Number(s):** ____

Clarification Form(s)? ✓ Yes ____ No **Clarification Form Page No.(s):** C-42A

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: 360T028	Side: ☐ Left (A) ☑ Right (B)	Date: 1-8-93

Assessment Engineer(s)/Inspector(s): WILKES / FRESTON

Nozzle Subassembly: AFT EXIT CONE ASSY

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface: Distance From Fwd	Location on Bonding Surface: Distance From Aft
1	.30	.50	11.75	
42	.60	.40	33.75	
43	.70	.50	34.30	
47	.38	.52	31.38	
98	1.30	.88	3.75	
242	1.20	.75	28.20	
285	.50	.50	42.25	
320	1.10	.50	6.75	
353	.50	.70	7.75	
354	.75	.40	9.80	

Notes / Comments TYPICALLY VERY FEW SMALL ADHESIVE VOIDS (.500 DIA MAX) WERE OBSERVED AROUND CIRCUMFERENCE.

Corresponding Comment Number(s): 1

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-12

Nozzle Subassembly Phenolic Bondline Condition

Motor No.: 360T028	Side: Right (B)	Date: 12/15/92

Assessment Engineer(s)/Inspector(s): J. WALKER E. DIEHL

Phenolic Subassembly: Forward Exit Cone Assembly

Record Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

Degree Location

	0-45	45-90	90-135	135-180	180-225	225-270	270-315	315-360
Metal-to-Adhesive	10	07	15	7	5	5	7	10
Within Adhesive	15	15	15	15	15	15	15	15
Adhesive-to-GCP	75	78	70	78	80	80	78	75
Within GCP								
GCP-to-CCP								
Within CCP								

Record Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

Degree Location

Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-GCP								

Phenolic Removal Method: ______

Metal Housing Bondline Surface Observations:

	Yes	No	Comment #
A. Soot?		X	
B. Voids in Adhesive?	X		1
C. Corrosion?	X		2
D. Foreign Material?		X	

Notes / Comments

1) VOIDS DOCUMENTED ON CLARIFICATION FORM C-43A

2) MEDIUM - TO - HEAVY CORROSION ON AREAS OF METAL-TO-ADHESIVE SEPARATION

Preliminary PFAR(s)? ____ Yes __X__ No Preliminary PFAR Number(s): ______

Clarification Form(s)? __X__ Yes ____ No Clarification Form Page No.(s): C-43A

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: 360T028	Side: ☐ Left (A) ☒ Right (B)	Date: 12/15/92
Assessment Engineer(s)/Inspector(s): J. WALKER E. DIEHL		
Nozzle Subassembly: FORWARD EXIT CONE		

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface: Distance From Fwd	Location on Bonding Surface: Distance From Aft
4°	1.10"	.60"	15.5"	
163°	.95"	.50"		5.7"
176°	1.30"	.60"	9.0"	
261°	1.20"	.30"		12.6"
261°	.60"	.20"		14.9"
261°	.65"	.20"		15.9"
261°	2.70"	.85"		16.75"
294°	1.15"	.50"		9.8"
278°	.65"	.40"		7.6"
317°	.95"	.50"		2.1"
332°	.65"	.40"	11.1"	
340°	1.35"	.70"	2.9"	
351°	2.70"	.85"	7.8"	

Notes / Comments

ORIGINAL PAGE IS OF POOR QUALITY

Corresponding Comment Number(s): 1

REVISION ____

POSTFLIGHT OBSERVATION RECORD (PFOR) C-12
Nozzle Subassembly Phenolic Bondline Condition

Motor No.: 360T028	Side: Right (B)	Date: 12/16/92

Assessment Engineer(s)/Inspector(s): T. WALKER T. FRESTON

Phenolic Subassembly: Throat Assembly

Record Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

Degree Location	0	45	90	135	180	225	270	315
Metal-to-Adhesive	65	100	100	100	100	95	100	100
Within Adhesive								
Adhesive-to-GCP						5		
Within GCP								
GCP-to-CCP	35							
Within CCP								

Record Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

Degree Location	NR							
Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-GCP								

Phenolic Removal Method: ______

Metal Housing Bondline Surface Observations:	Yes	No	Comment #
A. Soot?		✓	
B. Voids in Adhesive?	✓		1
C. Corrosion?	✓		2
D. Foreign Material?		✓	

Notes / Comments

1) VOIDS ARE DOCUMENTED ON PAGE C-44A

2. MED TO HEAVY AROUND ENTIRE CIRCUMFERENCE

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? X Yes ____ No Clarification Form Page No.(s): C-44A

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: 360T028	Side: ☐ Left (A) ☒ Right (B)	Date: 12/16/92

Assessment Engineer(s)/Inspector(s): J. WALKER T. FRESTON

Nozzle Subassembly: THROAT ASSY.

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface Distance From Fwd	Location on Bonding Surface Distance From Aft
145°	.80"	.30"		17.4"
Δ NOTE:	THE	FOLLOWING	ARE "WORM HOLE"	TYPE
	VOIDS.	AXIAL &	CIRCUMFERENTIAL	DIMENSIONS
	ARE	MAXIMUMS	OF THE AFFECTED	REGION
260°	3.0"	3.0"	"WORM HOLE"	3.0
270°	1.2"	1.2"	"WORM HOLE"	1.2
280°	.6"	.6"	"WORM HOLE"	.6

Notes / Comments

Corresponding Comment Number(s): 1

REVISION ____

POSTFLIGHT OBSERVATION RECORD (PFOR) C-12
Nozzle Subassembly Phenolic Bondline Condition

Motor No.: 360T028 | Side: Right (B) | Date: 1-18-93

Assessment Engineer(s)/Inspector(s): MILLER / WILKES / DIEHL

Phenolic Subassembly: Aft Inlet/Forward Nose Rings

Record Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

	Degree Location							
	0-45	45-90	90-135	135-180	180-225	225-270	270-315	315-360
Metal-to-Adhesive	100	100	95	100	100	100	90	85
Within Adhesive							5	
Adhesive-to-GCP			5				5	15
Within GCP								
GCP-to-CCP								
Within CCP								

Record Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

NA

	Degree Location							
	0-45	45-90	90-135	135-180	180-225	225-270	270-315	315-360
Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-GCP								

Phenolic Removal Method: HAMMER & WEDGE

Metal Housing Bondline Surface Observations:	Yes	No	Comment #
A. Soot?		✓	
B. Voids in Adhesive?	✓		1
C. Corrosion?	✓		2
D. Foreign Material?		✓	

Notes / Comments ① SEE PFOR CLARIFICATION FORM PAGE 45A & NOTE 1.
② MEDIUM TO HEAVY CORROSION OVER 95% OF BONDLINE AREA.
③ SPECIAL ISSUES, DR-407597 AT 283°. SEE PFOR CLARIFICATION FORM PAGE C-45A NOTE 2.

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ✓ Yes ____ No   Clarification Form Page No.(s): C-45A

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: 360T028 | Side: ☐ Left (A) ☑ Right (B) | Date: 1-18-93

Assessment Engineer(s)/Inspector(s): WILKES / DIEHL / MILLER

Nozzle Subassembly: NOSE INLET RINGS (-503 & -504)

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface: Distance From Fwd METAL-TO-AFT	Location on Bonding Surface: Distance From Aft
140	.30	.20	.60	
161	.30	.20	.70	

Notes / Comments ① TYPICAL SMALL ADHESIVE VOIDS, .30 IN DIA MAXIMUM WERE OBSERVED THROUGHOUT BOUNDLINE.

② A SMALL ADHESIVE VOID WAS OBSERVED AT FORWARD END AT 282° WHICH DOES NOT CORRELATE CLOSELY WITH SIZE OF LDA ON DR-407597 AT 283°. OBSERVED VOID MEASURED 0.10 DIA.

Corresponding Comment Number(s): 1

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-12
Nozzle Subassembly Phenolic Bondline Condition

Motor No.: 360T028	Side: Right (B)	Date: 1-18-93

Assessment Engineer(s)/Inspector(s): MILLER / WILKES / DIEHL

Phenolic Subassembly: Nose Cap

Record Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

Degree Location

	0-360							
Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-GCP								
Within GCP								
GCP-to-CCP	100							
Within CCP								

Record Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

Degree Location

	0-45	45-90	90-135	135-180	180-225	225-270	270-315	315-360
Metal-to-Adhesive	20	15	20	20	35	20	30	20
Within Adhesive								
Adhesive-to-GCP	80	85	80	80	65	80	70	80

Phenolic Removal Method: WEDGE & PEEL

Metal Housing Bondline Surface Observations:	Yes	No	Comment #
A. Soot?		✓	
B. Voids in Adhesive?	✓		1
C. Corrosion?	✓		3
D. Foreign Material?		✓	

Notes / Comments (1) SEE PFOR CLARIFICATION FORM PAGE C-46A & NOTE 1

(2) Special Issues 3.3.2, 3.3.3, and 3.3.4: SEE PFOR CLARIFICATION FORM PAGE C-46A NOTE 2

(3) TYPICAL LIGHT TO MEDIUM CORROSION ON FWD 1.0 IN. MAX INTERMITTENTLY AROUND 60% CIRCUM. AND ON AFT 2.75 IN. MAX AROUND FULL CIRCUM.

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ✓ Yes ____ No Clarification Form Page No.(s): C-46A

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: 360T028	Side: ☐ Left (A) ☑ Right (B)	Date: 1-18-93
Assessment Engineer(s)/Inspector(s): WILKES / DIEHL / MILLER		
Nozzle Subassembly: NOSE CAP		

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface: Distance From Fwd	Location on Bonding Surface: Distance From Aft
			METAL-TO-AFT	
131	.30	.20	12.70	
178	.35	.20	10.40	
259	.30	.15	8.50	
297	.34	.21	7.80	
			METAL-TO-FWD	
*13	.35	.15	1.3	
* 267	.34	.17	1.45	

* NOSE CAP-TO-FWD NOSE RING INTERFACE.

Notes / Comments ① TYPICAL SMALL ADHESIVE VOIDS, 0.30 IN. DIA. MAXIMUM, WERE OBSERVED THROUGHOUT BONDLINE.

② ADHESIVE VOID AT 178° CORRELATES CLOSELY WITH LDA ON DR 407597 AT 177°. NO VOID WAS OBSERVED AT 244° PER DR 407597 BUT THE HYDRO-LASE CUT 245° MAY HAVE DESTROYED ADHESIVE EVIDENCE ON NOSE CAP.
ADHESIVE VOIDS IN NOSE CAP-TO-NOSE INLET RING AT 13° AND 267° CORRELATE CLOSELY WITH LDA'S ON DR-407597. ALL OTHER LDA'S (SEVEN) COULD NOT BE FOUND BUT ALL WERE IN OR NEAR THE CCP CHAR AND EROSION AREA AND EVIDENCE MAY HAVE BE BURNED OFF.

Corresponding Comment Number(s): 1

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-12
Nozzle Subassembly Phenolic Bondline Condition

Motor No.: 360T028	Side: Right (B)	Date: 12-18-92

Assessment Engineer(s)/Inspector(s): M. Clark

Phenolic Subassembly: Cowl Assembly

Record Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

Degree Location

	315-45	45-135	135-225	225-315				
Metal-to-Adhesive	100	100	100	100				
Within Adhesive								
Adhesive-to-SCP								
Within SCP								
SCP-to-CCP								
Within CCP								

Record Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

Degree Location

	N/A							
Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-SCP								

Phenolic Removal Method: ______

Metal Housing Bondline Surface Observations:	Yes	No	Comment #
A. Soot?		✓	
B. Voids in Adhesive?	✓		1
C. Corrosion?	✓		2
D. Foreign Material?		✓	

Notes / Comments

1) Special Issue 3.3.7: All LDIs were found to be adhesive voids
Reference C-47A
2) Medium-to-heavy corrosion on the bonding surface
0°-360°

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ✓ Yes ____ No   Clarification Form Page No.(s): C-47A

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: 360T028	Side: ☐ Left (A) ☒ Right (B)	Date: 12-18-92
Assessment Engineer(s)/Inspector(s): M. Clark, T. Freston		
Nozzle Subassembly: Cowl		

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface: Distance From Fwd	Location on Bonding Surface: Distance From Aft
10	0.56	2.6	0	
30 *	2.54	fwd 6.0, 0.28	0	
100 *	2.30	6.1, .68	0	
190 *	2.58	5.75, .75	0	
240 *	2.7	.48	0	

Notes / Comments
* Voids match LDIs detected by X-ray

Corresponding Comment Number(s): ______

REVISION ____

DOC NO. TWR-64216 | VOL
SEC | PAGE C-47a

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-12
Nozzle Subassembly Phenolic Bondline Condition

Motor No.: 360T028	**Side:** Right (B)	**Date:** 12-17-92

Assessment Engineer(s)/Inspector(s): WILKES, MILLER

Phenolic Subassembly: Fixed Housing Assembly

Record Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

Degree Location

	45-135	135-225	225-315	315-45				TOTAL
Metal-to-Adhesive	30	75	40	73				54
Within Adhesive								
Adhesive-to-GCP	10	22	30	25				22
Within GCP	60	3	30	2				24
GCP-to-CCP								
Within CCP								

METAL-TO-ADHESIVE SEPARATION EXCEEDS 15%
A PRELIMINARY PFAR WAS WRITTEN

Record Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

Degree Location

	45-135	135-225	225-315	315-45				
Metal-to-Adhesive			40					
Within Adhesive								
Adhesive-to-GCP	[illegible]	100	60	100				

(50%) METAL/ADHESIVE

Phenolic Removal Method: MUCH HAMMERING ON WEDGE & PEEL

Metal Housing Bondline Surface Observations:	Yes	No	Comment #
A. Soot?		✓	
B. Voids in Adhesive?	X		1
C. Corrosion?		✓	
D. Foreign Material?		X	

Notes / Comments

1) SEE PAGE C-48A FOR VOIDS
2) A DARK LINE WAS STAINED ON THE HOUSING. SEE C-48 B&C
3) 8 INDICATIONS WERE FOUND BY ULTRASONICS. 2 SEPARATIONS WERE FOUND [illegible] POSSIBLE CORRELATIONS DURING ASSESSMENT SEE C-48 D&E

Preliminary PFAR(s)? X Yes ___ No Preliminary PFAR Number(s): S3d-07

Clarification Form(s)? X Yes ___ No Clarification Form Page No.(s): 48A-E

REVISION ___

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: 360T028 | Side: ☐ Left (A) ☒ Right (B) | Date: 12/18/92

Assessment Engineer(s)/Inspector(s): L. E WILKES P. MILLER

Nozzle Subassembly: FIXED HOUSING

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface Distance From Fwd	Location on Bonding Surface Distance From Aft
200	1.00	0.40		2.300
205	.70	.30		10.200
30	.50	.30		0.800

Notes / Comments

Corresponding Comment Number(s): /

REVISION ___

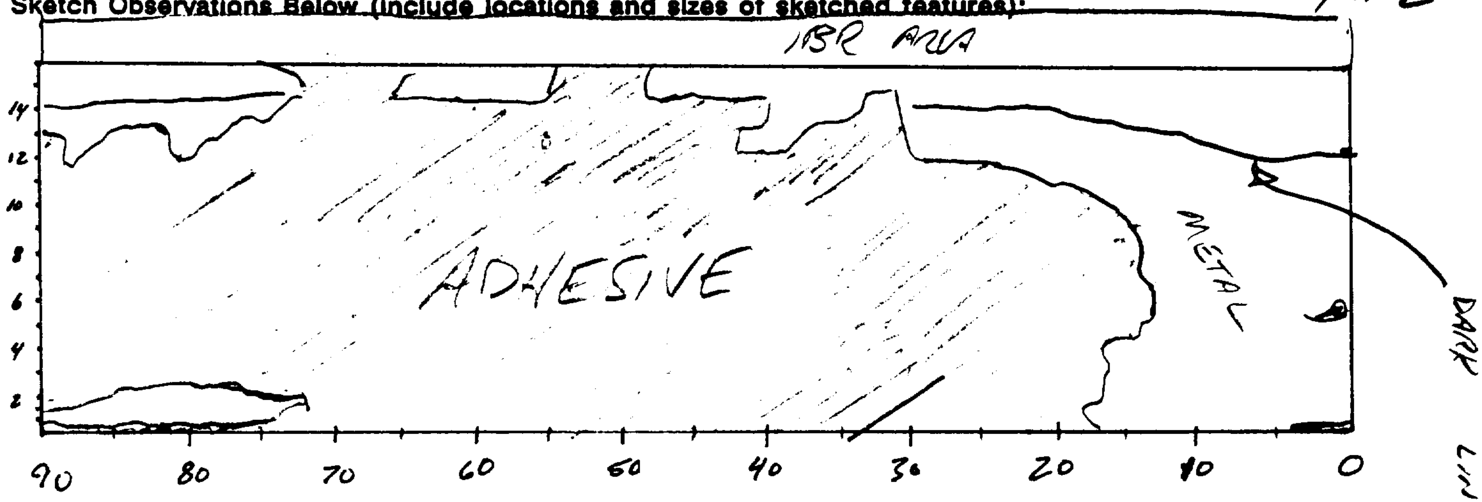
DOC NO. TWR-64216 VOL
SEC PAGE C-48a

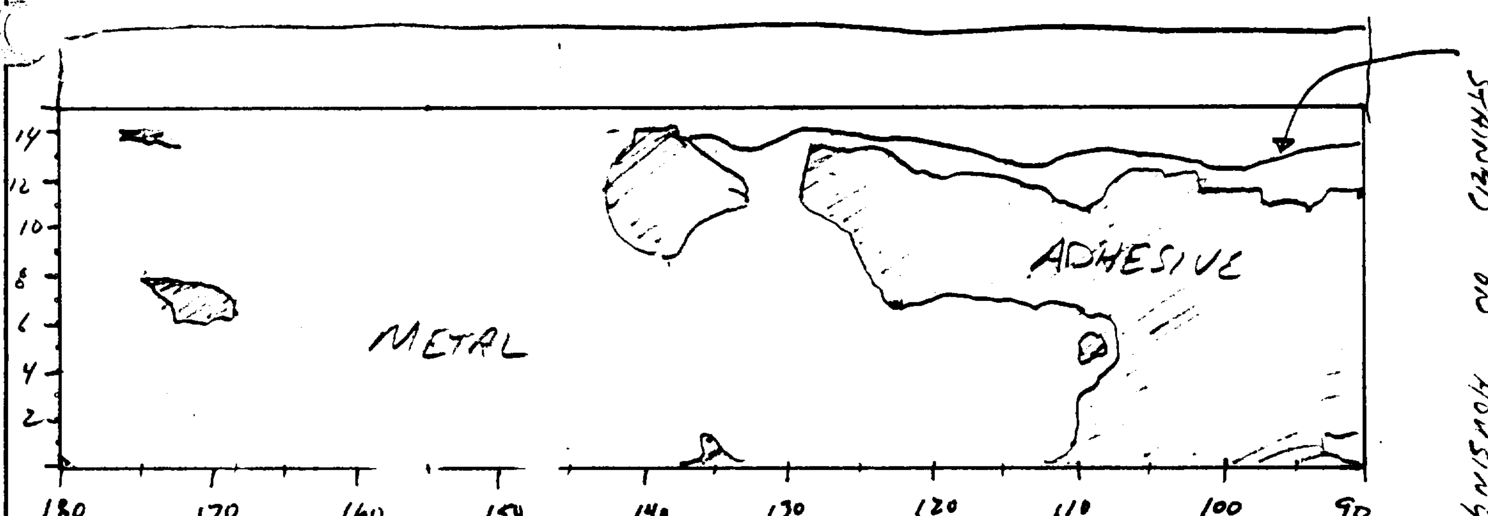
Thiokol CORPORATION
SPACE OPERATIONS

General Hardware Clarification Form

Motor No.: 360T028	Side: ☐ Left (A) ☒ Right (B)	Date: 12/18/92
Assessment Engineer(s)/Inspector(s): J. WALKER		
Description: FIXED HOUSING BONDLINE MAP: METAL SIDE		

Sketch Observations Below (include locations and sizes of sketched features): 1 of 2





Corresponding Comment Number(s): 2, 3

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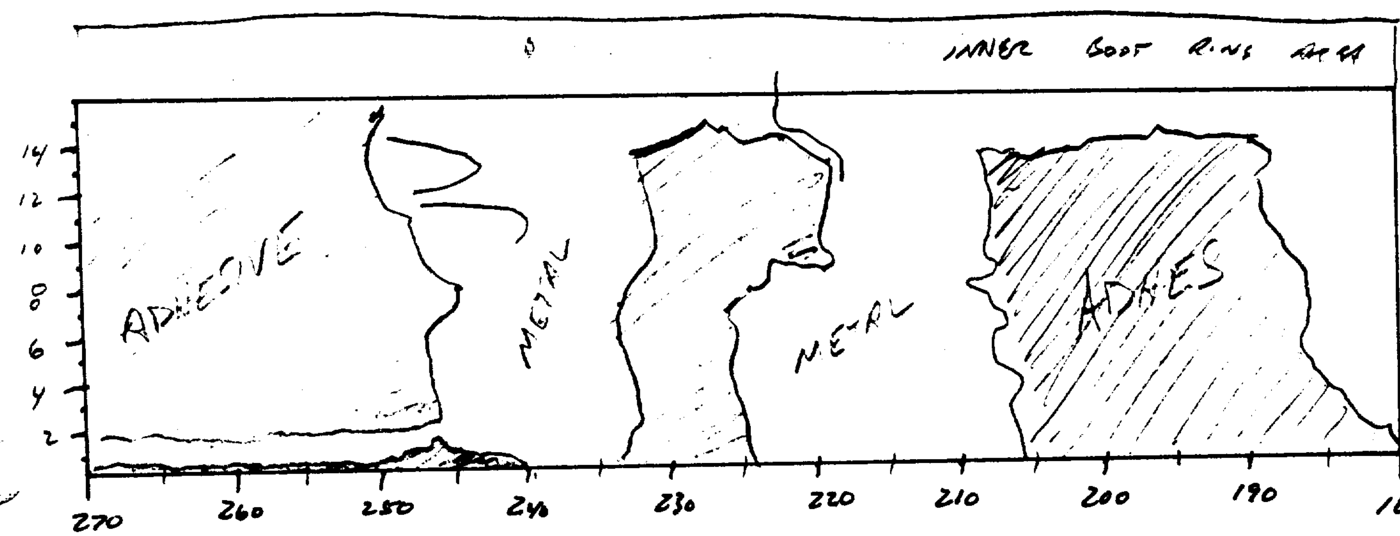
Thiokol CORPORATION
SPACE OPERATIONS

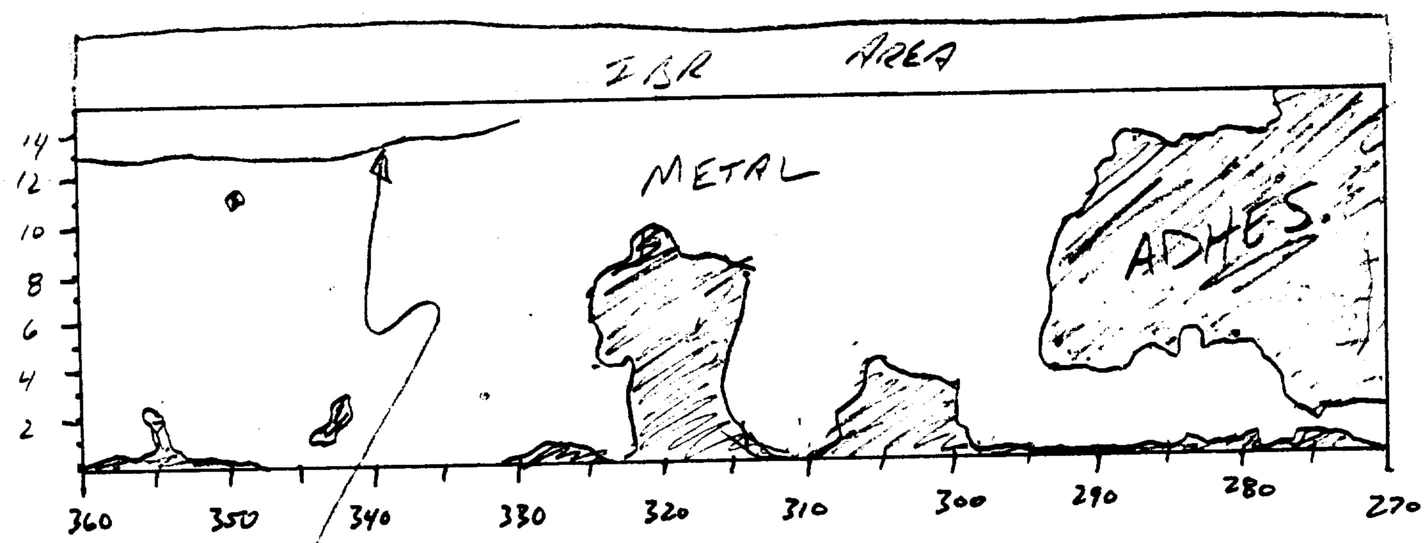
General Hardware Clarification Form

Motor No.: 360T028	Side: ☐ Left (A) ☒ Right (B)	Date: 12/18/92
Assessment Engineer(s)/Inspector(s): J. WALKER		
Description: FIXED HOUSING BONDLINE MAP: METAL SIDE		

Sketch Observations Below (include locations and sizes of sketched features): 2 of 2

DARK LINES STAINED ON HOUSING





DARK LINE STAINED ON HOUSING

Corresponding Comment Number(s): 2, 3

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

General Hardware Clarification Form

Motor No.: 360T028	Side: ☐ Left (A) ☒ Right (B)	Date: 12/18/92
Assessment Engineer(s)/Inspector(s): T.F. WALKER		
Description: ULTRASONIC INDICATIONS -VS- BONDLINE CONDITION		

Sketch Observations Below (include locations and sizes of sketched features):

ULTRASONIC INDICATIONS	BONDLINE CONDITION
(1) 50° - 70° 5.25" - 6.0" AFT OF FWD END	(1) NO UNBOND FOUND
(2) 83° - 88° 5.0" - 6.0" AFT OF FWD END	(2) UNBOND AREA FOUND W/ AN AXIAL WIDTH OF 0.8". AREA DEFINED BY A DARK LINE STAINED ON THE HOUSING
(3) 84° @ 12.5" AFT OF FWD 1" SQUARE AREA	(3) NO UNBOND FOUND
(4) 85° @ 15.5" AFT OF FWD 1" x 1.5" AREA	(4) NO UNBOND FOUND
(5) 90° - 105° 5.25" - 6.5" AFT OF FWD END	(5) UNBOND AREA FOUND W/ AN AXIAL WIDTH OF .5" @ 90° INCREASING TO 1.5" AT 100° - 105°. AREA DEFINED BY A DARK LINE STAINED ON THE HOUSING.
(6) 105° @ 11" AFT OF FWD END	(6) NO UNBOND FOUND

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Corresponding Comment Number(s): ______

REVISION ____

General Hardware Clarification Form

Motor No.: 360T028	Side: ☐ Left (A) ☒ Right (B)	Date: 12/18/92
Assessment Engineer(s)/Inspector(s): J. F. WALKER		
Description: ULTRASONIC INDICATIONS -VS- BONDLINE CONDITION		

Sketch Observations Below (include locations and sizes of sketched features):

ULTRASONIC INDICATIONS	BONDLINE CONDITION
7 175° - 188° 5" - 6" AFT OF FWD END	(POSSIBLE CORRELATION) 7 NO UNBOND EVIDENSE FOUND; HOWEVER, THIS AREA IS WITHIN AN AREA OF METAL -TO- ADHESIVE PRIMARY SEPARATION MODE. NO "DARK LINE" PRESENT.
8 180° - 200° 5" - 6" AFT OF FWD END INTERMITTENT	8 AS 7 ABOVE. (POSSIBLE CORRELATION)

ORIGINAL PAGE IS OF POOR QUALITY

Corresponding Comment Number(s): 2, 3

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-13
Cowl Ring Phenolic (CCP) Section Condition

Motor No.: 360T028	Side: Right (B)	Date: 5/18/93

Assessment Engineer(s)/Inspector(s): R. Quick

Cowl Phenolic Section Observations:

	Yes	No	Comment #
A. Cross-ply cracking in virgin material?		✓	
B. Ply lifting?	✓		1,2

Record the Cowl Char and Erosion Measurements Below:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
0.3	.23	.62	.23	.63	.23	.64	.20	.68
1.0	.29	.57	.29	.63	.30	.61	.24	.66
2.0	.33	.60	.33	.65	.35	.61	.29	.64
3.0	.35	.55	.38	.61	.40	.59	.29	.63
4.0	.34	.59	.39	.62	.40	.62	.29	.59
5.0		.99*		1.09*		1.03*		.99*
6.0		91*		1.09*		1.17*		1.05*
6.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Negative Margin of Safety? ____ Yes ✓ No Station: ____ Degree: ____

Notes / Comments 1-PLY LIFT AT 0° FROM STATION .3 TO 2.2

2-PLY LIFT AT 180° FROM STATION .3 TO 3

* TOTAL AFFECTED DEPTH

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-14
Forward Exit Cone Phenolic (CCP) Section Condition

Motor No.: 360T028	Side: Right (B)	Date: 5/18/93
Assessment Engineer(s)/Inspector(s): E. Quick		

Forward Exit Cone Phenolic Section Observations:

	Yes	No	Comment #
A. Cross-ply cracking in virgin material?		✓	
B. Ply lifting?		✓	

Record the Forward Exit Cone Char and Erosion Measurements Below:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
1.0	.32	.74	.32	.72	.39	.71	.37	.78
4.0	.36	.65	.33	.69	.38	.64	.39	.67
4.6	.34	.64	.29	.69	.36	.67	.39	.68
8.0	.34	.64					.42	.69
12.0	.23	.63						
16.0								
20.0								
24.0								
28.0								
32.0								
32.9								
34.0								

Negative Margin of Safety? ____ Yes ✓ No Station: ____ Degree: ____

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-15
Fixed Housing Phenolic (CCP) Section Condition

Motor No.: 360T028	Side: Right (B)	Date: 5/19/93
Assessment Engineer(s)/Inspector(s): R. Quick		

Fixed Housing Phenolic Section Observations:

	Yes	No	Comment #
A. Cross-ply cracking in virgin material?		✓	
B. Ply lifting?		✓	

Record the Fixed Housing Char and Erosion Measurements Below:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
0.0	.10	1.12	.10	1.08	.10	1.00	.12	1.13
1.0	.04	1.11	.08	1.11	.04	1.00	.03	1.02
2.0	.01	1.00	0	1.02	.04	.92	0	.99
3.0	0	.96	0	1.04	.04	.90	0	1.04
4.0	0	.93	0	1.03	.02	.91	0	1.01
5.0	0	.96	0	1.03	.03	.88	0	1.03
6.0	0	.95	0	1.00	.03	.89	0	.92
7.0	0	.92	0	.89	.03	.84	0	.92
8.0	0	.82	0	.71	0	.85	0	.80
9.0	0	.67	0	.75	0	.78	0	.98
10.75	0	1.58	0	1.83	0	1.79	0	1.72

Negative Margin of Safety? _____ Yes ✓ No Station: _____ Degree: _____

Notes / Comments

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Clarification Form Page No.(s): _____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-16

Throat Inlet Assembly Phenolic (CCP) Section Condition

Motor No.: 360T028 | Side: Right (B) | Date: 5/19/93

Assessment Engineer(s)/Inspector(s): E. Quick

Throat Inlet Assembly Phenolic Section Observations:

	Yes	No	Comment #
A. Cross-ply cracking in virgin material?		✓	
B. Ply lifting?		✓	

Record the Throat Inlet Ring and Throat Ring Char and Erosion Measurements Below:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
1.0	1.02	.56	1.08	.55	1.01	.60	1.11	.63
2.0	1.07	.56	1.15	.50	1.04	.58	1.08	.56
4.0	1.14	.54	1.21	.45	1.12	.50	1.07	.55
6.0	1.19	.58	1.23	.50	1.18	.54	1.26	.46
8.0	1.22	.51	1.25	.45	1.23	.54	WEDGE	OUT
10.0	1.18	.52	1.18	.47	1.19	.57	1.16	.50
12.0	1.16	.48	1.19	.46	1.18	.54	1.15	.51
14.0	1.18	.53	1.15	.44	1.16	.55	1.12	.58
16.0	1.10	.47	1.09	.53	1.09	.54	1.05	.60
18.0	.96	.49	.93	.75	.99	.55	.95	.59
20.0	.84	.55	.76	.62	.78	.61	.71	.71
22.0	.55	.56	.47	.62	.55	.67	.48	.71
23.0	.47	.54	.38	.58	.45	.70	.36	.73

Negative Margin of Safety? ____ Yes ✓ No Station: ____ Degree: ____

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-17
Nose Cap Phenolic (CCP) Section Condition

Motor No.: 360T028 | Side: Right (B) | Date: 5/20/93

Assessment Engineer(s)/Inspector(s): R. Quick

Nose Cap Phenolic Section Observations:

	Yes	No	Comment #
A. Cross-ply cracking in virgin material?		✓	
B. Ply lifting?		✓	

Record the Nose Cap Char and Erosion Measurements Below:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
1.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4.0	.36	.58	.43	.51	.36	.50	.30	.59
6.0	.37	.52	.45	.45	.38	.46	.33	.51
8.0	.46	.54	.49	.46	.49	.46	.41	.46
10.0	.51	.49	.49	.42	.49	.42	.42	.47
12.0	.52	.51	.58	.47	.58	.47	.47	.44
14.0	.55	.52	.73	.35	.66	.37	.48	.52
16.0	.67	.42	.74	.43	.74	.34	.61	.44
18.0	.78	.42	.86	.41	.78	.38	.68	.46
20.0	.96	.42	1.08	.40	1.08	.40	.86	.49
22.0	1.43	.65	1.68	.57	1.68	.57	1.35	.55
24.0	1.65	.75	1.83	.64	1.83	.64	1.57	.76
26.0	1.14	.82	1.31	.61	1.31	.61	1.10	.82

Negative Margin of Safety? ______ Yes ✓ No Station: ______ Degree: ______

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-18

Forward Nose Ring and Aft Inlet Ring Phenolic (CCP) Section Condition

Motor No.: 360T028	Side: Right (B)	Date: 5/20/93

Assessment Engineer(s)/Inspector(s): R. Quick

Forward Nose and Aft Inlet Ring Phenolic Section Observations:

	Yes	No	Comment #
A. Cross-ply cracking in virgin material?		✓	
B. Ply lifting?		✓	

Record the Forward Nose Ring (-503) Char and Erosion Measurements Below:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
28.0	1.16	.65	1.15	.68	1.20	.71	1.03	.74
30.0	.91	.66	.94	.62	.93	.72	.93	.68
32.0	.92	.66	.93	.67	.93	.65	.97	.62

Negative Margin of Safety? ______ Yes ______ No Station: ______ Degree: ______

Record the Aft Inlet Ring Char (-504) and Erosion Measurements Below:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
34.0	.84	.59	.92	.60	.89	.63	.89	.59
36.0	.88	.56	.93	.61	.94	.57	.92	.63
38.0	.96	.57	1.01	.64	1.02	.58	1.01	.58
39.0	.96	.58	1.03	.67	1.02	.61	.92	.60

Negative Margin of Safety? ______ Yes ✓ No Station: ______ Degree: ______

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

REVISION ___

Thiokol CORPORATION
SPACE OPERATIONS

General Hardware Clarification Form

Motor No.: 360T028 | Side: ☑ Left (A) ☐ Right (B) | Date: 5/20/93

Assessment Engineer(s)/Inspector(s): R. Quick

Description: AFT EXIT CONE ASSEMBLY

Sketch Observations Below (include locations and sizes of sketched features):

DEGREE	0		18		30		90		128	
STATION	EROSION	CHAR	EROSION	CHAR	EROSION	CHAR	EROSION	CHAR	EROSION	CHAR
101.77										
107.77			.17	.55	.16	.50				
113.77	.15	.56	.18	.57	.18	.54	.17	.60	.12	.60
119.77										

DEGREE	180		220		225		263		270	
STATION	EROSION	CHAR	EROSION	CHAR	EROSION	CHAR	EROSION	CHAR	EROSION	CHAR
101.77							.16	.59	.15	.58
107.77	.12	.58	.14	.56			.15	.51	.16	.54
113.77	.12	.60	.12	.63			.14	.55	.16	.54
119.77										

DEGREE	278		255°							
STATION	EROSION	CHAR	EROSION	CHAR	EROSION	CHAR	EROSION	CHAR	EROSION	CHAR
101.77	.11	.64	.12	.55						
107.77	.13	.51	.15	.55						
113.77	.16	.61	.15	.57						
119.77										

Negative Margin of Safety Yes ____ No ✓ Station: ____ Degree: ____

AFT EXIT CONE PHENOLIC SECTION OBSERVATIONS:

	Yes	No	Comments #
A. Cross-ply cracking in virgin material?		✓	
B. Ply lifting?		✓	

Corresponding Comment Number(s): ____________

TWR-64216

Solid Rocket Motor
Thiokol Corporation

Appendix D
Nozzle Postfire Data

Final Postflight Hardware Evaluation Report
RSRM-28 (STS-53)

November 1993

Prepared for:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER
MARSHALL SPACE FLIGHT CENTER, ALABAMA 35812

Contract No.	NAS8-38100
DR No.	4-23
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ECS No.	SS4771

Thiokol CORPORATION
SPACE OPERATIONS

P.O. Box 707, Brigham City, Utah 84302-0707 (801) 863-3511

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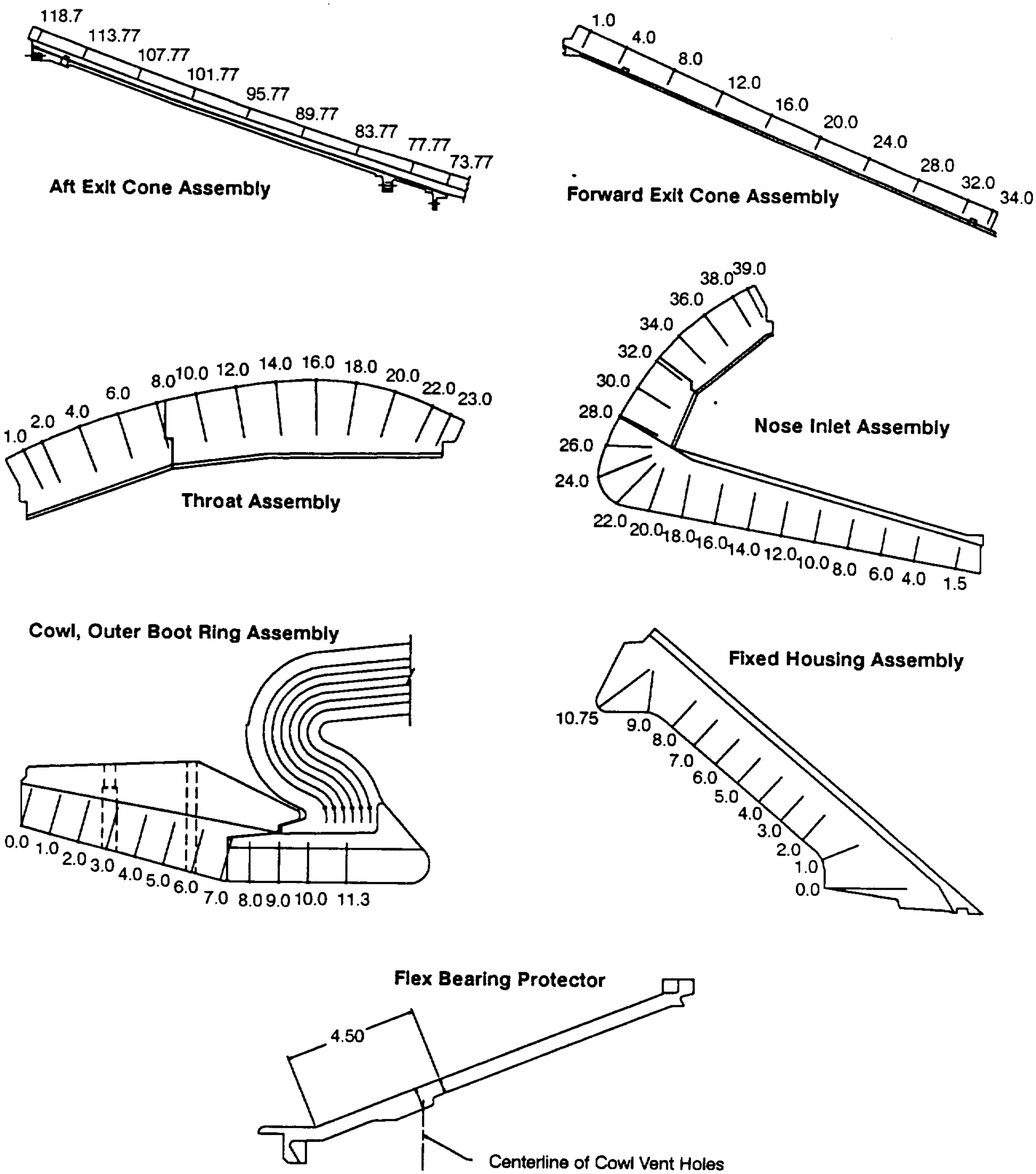

Figure D-1. RSRM Nozzle Liner Char and Erosion Station Locations

Table D-I. RSRM-28A Forward Exit Cone Assembly Char and Erosion Data

Angular Location	Stations											
0 degrees	1.0	4.0	4.6	8.0	12.0	16.0	20.0	24.0	28.0	32.0	32.9	34.0
Measured Erosion	0.37	0.38	0.36	NA	NA	NA	NA	NA	NA	NA	NA	NA
Measured Char	0.80	0.74	0.74	NA	NA	NA	NA	NA	NA	NA	NA	NA
Adjusted Char *	0.64	0.59	0.59	NA	NA	NA	NA	NA	NA	NA	NA	NA
Denomenator	1.43	1.39	1.13	NA	NA	NA	NA	NA	NA	NA	NA	NA
RSRM Liner Thickness	1.807	1.731	1.411	NA	NA	NA	NA	NA	NA	NA	NA	NA
Margin of Safety	0.26	0.25	0.25	NA	NA	NA	NA	NA	NA	NA	NA	NA
90 degrees												
Measured Erosion	0.34	0.34	0.34	NA	NA	NA	NA	NA	NA	NA	NA	NA
Measured Char	0.77	0.75	0.76	NA	NA	NA	NA	NA	NA	NA	NA	NA
Adjusted Char *	0.62	0.60	0.61	NA	NA	NA	NA	NA	NA	NA	NA	NA
Denomenator	1.35	1.33	1.12	NA	NA	NA	NA	NA	NA	NA	NA	NA
RSRM Liner Thickness	1.807	1.731	1.411	NA	NA	NA	NA	NA	NA	NA	NA	NA
Margin of Safety	0.34	0.30	0.26	NA	NA	NA	NA	NA	NA	NA	NA	NA
180 degrees												
Measured Erosion	0.35	0.33	0.35	NA	NA	NA	NA	NA	NA	NA	NA	NA
Measured Char	0.74	0.76	0.73	NA	NA	NA	NA	NA	NA	NA	NA	NA
Adjusted Char *	0.59	0.61	0.58	NA	NA	NA	NA	NA	NA	NA	NA	NA
Denomenator	1.33	1.32	1.11	NA	NA	NA	NA	NA	NA	NA	NA	NA
RSRM Liner Thickness	1.807	1.731	1.411	NA	NA	NA	NA	NA	NA	NA	NA	NA
Margin of Safety	0.35	0.31	0.27	NA	NA	NA	NA	NA	NA	NA	NA	NA
270 degrees												
Measured Erosion	0.34	0.34	0.34	NA	NA	NA	NA	NA	NA	NA	NA	NA
Measured Char	0.80	0.80	0.80	NA	NA	NA	NA	NA	NA	NA	NA	NA
Adjusted Char *	0.64	0.64	0.64	NA	NA	NA	NA	NA	NA	NA	NA	NA
Denomenator	1.38	1.38	1.15	NA	NA	NA	NA	NA	NA	NA	NA	NA
RSRM Liner Thickness	1.807	1.731	1.411	NA	NA	NA	NA	NA	NA	NA	NA	NA
Margin of Safety	0.31	0.26	0.23	NA	NA	NA	NA	NA	NA	NA	NA	NA

Minimum margin of safety is 0.23 at station 4.60 degree 270.00
Maximum margin of safety is 0.35 at station 1.00 degree 180.00

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{1.50 \times \text{erosion} + 1.00 \times \text{adj char *}} - 1$$

Table D-II. RSRM-28B Forward Exit Cone Assembly Char and Erosion Data

Angular Location	Stations											
0 degrees	1.0	4.0	4.6	8.0	12.0	16.0	20.0	24.0	28.0	32.0	32.9	34.0
Measured Erosion	0.32	0.36	0.34	0.34	0.23	NA	NA	NA	NA	NA	NA	NA
Measured Char	0.74	0.65	0.64	0.64	0.63	NA	NA	NA	NA	NA	NA	NA
Adjusted Char *	0.59	0.52	0.51	0.51	0.50	NA	NA	NA	NA	NA	NA	NA
Denomenator	1.28	1.26	1.02	1.22	1.02	NA	NA	NA	NA	NA	NA	NA
RSRM Liner Thickness	1.807	1.731	1.411	1.629	1.524	NA	NA	NA	NA	NA	NA	NA
Margin of Safety	0.41	0.37	0.38	0.34	0.49	NA	NA	NA	NA	NA	NA	NA
90 degrees												
Measured Erosion	0.32	0.33	0.29	NA	NA	NA	NA	NA	NA	NA	NA	NA
Measured Char	0.72	0.69	0.69	NA	NA	NA	NA	NA	NA	NA	NA	NA
Adjusted Char *	0.58	0.55	0.55	NA	NA	NA	NA	NA	NA	NA	NA	NA
Denomenator	1.26	1.25	0.99	NA	NA	NA	NA	NA	NA	NA	NA	NA
RSRM Liner Thickness	1.807	1.731	1.411	1.629	1.524	NA	NA	NA	NA	NA	NA	NA
Margin of Safety	0.43	0.38	0.43	NA	NA	NA	NA	NA	NA	NA	NA	NA
180 degrees												
Measured Erosion	0.39	0.38	0.36	NA	NA	NA	NA	NA	NA	NA	NA	NA
Measured Char	0.71	0.64	0.67	NA	NA	NA	NA	NA	NA	NA	NA	NA
Adjusted Char *	0.57	0.51	0.54	NA	NA	NA	NA	NA	NA	NA	NA	NA
Denomenator	1.37	1.29	1.08	NA	NA	NA	NA	NA	NA	NA	NA	NA
RSRM Liner Thickness	1.807	1.731	1.411	1.629	1.524	NA	NA	NA	NA	NA	NA	NA
Margin of Safety	0.32	0.35	0.31	NA	NA	NA	NA	NA	NA	NA	NA	NA
270 degrees												
Measured Erosion	0.37	0.39	0.39	0.42	NA	NA	NA	NA	NA	NA	NA	NA
Measured Char	0.78	0.67	0.68	0.69	NA	NA	NA	NA	NA	NA	NA	NA
Adjusted Char *	0.62	0.54	0.54	0.55	NA	NA	NA	NA	NA	NA	NA	NA
Denomenator	1.41	1.33	1.13	1.40	NA	NA	NA	NA	NA	NA	NA	NA
RSRM Liner Thickness	1.807	1.731	1.411	1.629	1.524	NA	NA	NA	NA	NA	NA	NA
Margin of Safety	0.28	0.30	0.25	0.16	NA	NA	NA	NA	NA	NA	NA	NA

Minimum margin of safety is 0.16 at station 8.00 degree 270.00
Maximum margin of safety is 0.49 at station 12.00 degree 0.00

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{1.70 \times \text{erosion} + 1.25 \times \text{adj char}^{*}} - 1$$

Table D-III. RSRM-28A Throat Assembly Char and Erosion Data

Angular Location	Stations												
0 degrees	1.0	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0	23.0
Measured Erosion	1.04	1.15	1.12	1.17	1.21	1.22	1.19	1.16	1.08	1.07	0.78	0.51	0.39
Measured Char	0.54	0.53	0.50	0.51	0.50	0.41	0.37	0.47	0.55	0.58	0.61	0.62	0.69
Adjusted Char *	0.41	0.40	0.38	0.38	0.38	0.31	0.28	0.35	0.41	0.46	0.49	0.50	0.55
Denomenator	2.59	2.80	2.71	2.82	2.89	2.82	2.73	2.76	2.68	2.72	2.17	1.64	1.47
RSRM Liner Thickness	3.174	3.247	3.314	3.280	3.183	3.397	3.517	3.626	3.710	3.586	3.231	2.583	2.110
Margin of Safety	0.23	0.16	0.22	0.16	0.10	0.20	0.29	0.31	0.39	0.32	0.49	0.57	0.44
90 degrees													
Measured Erosion	1.01	1.03	1.09	1.13	1.21	1.18	1.12	1.13	1.07	0.93	0.73	0.48	0.40
Measured Char	0.47	0.52	0.54	0.56	0.48	0.47	0.44	0.42	0.42	0.52	0.55	0.62	0.71
Adjusted Char *	0.35	0.39	0.41	0.42	0.36	0.35	0.33	0.32	0.32	0.42	0.44	0.50	0.57
Denomenator	2.46	2.55	2.69	2.78	2.87	2.80	2.65	2.65	2.53	2.38	2.01	1.58	1.51
RSRM Liner Thickness	3.174	3.247	3.314	3.280	3.183	3.397	3.517	3.626	3.710	3.586	3.231	2.583	2.110
Margin of Safety	0.29	0.27	0.23	0.18	0.11	0.21	0.33	0.37	0.46	0.51	0.61	0.63	0.40
180 degrees													
Measured Erosion	1.02	1.05	1.11	1.12	1.17	1.17	1.17	1.14	1.09	0.92	0.68	0.44	0.36
Measured Char	0.47	0.48	0.46	0.52	0.46	0.40	0.36	0.37	0.44	0.59	0.64	0.67	0.73
Adjusted Char *	0.35	0.36	0.35	0.39	0.35	0.30	0.27	0.28	0.33	0.47	0.51	0.54	0.58
Denomenator	2.48	2.55	2.65	2.73	2.77	2.71	2.68	2.63	2.59	2.43	2.00	1.55	1.45
RSRM Liner Thickness	3.174	3.247	3.314	3.280	3.183	3.397	3.517	3.626	3.710	3.586	3.231	2.583	2.110
Margin of Safety	0.28	0.27	0.25	0.20	0.15	0.25	0.31	0.38	0.43	0.48	0.62	0.67	0.46
270 degrees													
Measured Erosion	1.05	1.05	1.12	1.16	1.20	1.18	1.17	1.13	1.08	0.93	0.85	0.53	0.37
Measured Char	0.47	0.49	0.52	0.55	0.58	0.44	0.47	0.47	0.49	0.51	0.56	0.56	0.70
Adjusted Char *	0.35	0.37	0.39	0.41	0.43	0.33	0.35	0.35	0.37	0.41	0.45	0.45	0.56
Denomenator	2.54	2.56	2.73	2.84	2.94	2.77	2.78	2.70	2.62	2.37	2.26	1.62	1.44
RSRM Liner Thickness	3.174	3.247	3.314	3.280	3.183	3.397	3.517	3.626	3.710	3.586	3.231	2.583	2.110
Margin of Safety	0.25	0.27	0.22	0.16	0.08	0.23	0.26	0.34	0.42	0.51	0.43	0.59	0.47

Minimum margin of safety is 0.08 at station 8.00 degree 270.00
Maximum margin of safety is 0.67 at station 22.00 degree 180.00

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{2.00 \times \text{erosion} + 1.25 \times \text{adj char}^{*}} - 1$$

Table D-IV. RSRM-28B Throat Assembly Char and Erosion Data

Angular Location	Stations												
0 degrees	1.0	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0	23.0
Measured Erosion	1.02	1.07	1.14	1.19	1.22	1.18	1.16	1.18	1.10	0.96	0.84	0.55	0.47
Measured Char	0.56	0.56	0.54	0.58	0.51	0.52	0.48	0.53	0.47	0.49	0.55	0.56	0.54
Adjusted Char *	0.42	0.42	0.41	0.43	0.38	0.39	0.36	0.40	0.35	0.39	0.44	0.45	0.43
Denomenator	2.56	2.67	2.79	2.92	2.92	2.85	2.77	2.86	2.64	2.41	2.23	1.66	1.48
RSRM Liner Thickness	3.174	3.247	3.314	3.280	3.183	3.397	3.517	3.626	3.710	3.586	3.231	2.583	2.110
Margin of Safety	0.24	0.22	0.19	0.12	0.09	0.19	0.27	0.27	0.40	0.49	0.45	0.56	0.43
90 degrees													
Measured Erosion	1.08	1.15	1.21	1.23	1.25	1.18	1.19	1.15	1.09	0.93	0.76	0.47	0.38
Measured Char	0.55	0.50	0.45	0.50	0.45	0.47	0.46	0.44	0.53	0.75	0.62	0.62	0.58
Adjusted Char *	0.41	0.38	0.34	0.38	0.34	0.35	0.35	0.33	0.40	0.60	0.50	0.50	0.46
Denomenator	2.68	2.77	2.84	2.93	2.92	2.80	2.81	2.71	2.68	2.61	2.14	1.56	1.34
RSRM Liner Thickness	3.174	3.247	3.314	3.280	3.183	3.397	3.517	3.626	3.710	3.586	3.231	2.583	2.110
Margin of Safety	0.19	0.17	0.17	0.12	0.09	0.21	0.25	0.34	0.39	0.37	0.51	0.66	0.57
180 degrees													
Measured Erosion	1.01	1.04	1.12	1.18	1.23	1.19	1.18	1.16	1.09	0.99	0.78	0.55	0.45
Measured Char	0.60	0.58	0.50	0.54	0.54	0.57	0.54	0.55	0.54	0.55	0.61	0.67	0.70
Adjusted Char *	0.45	0.43	0.38	0.41	0.41	0.43	0.41	0.41	0.41	0.44	0.49	0.54	0.56
Denomenator	2.58	2.62	2.71	2.87	2.97	2.91	2.87	2.84	2.69	2.53	2.17	1.77	1.60
RSRM Liner Thickness	3.174	3.247	3.314	3.280	3.183	3.397	3.517	3.626	3.710	3.586	3.231	2.583	2.110
Margin of Safety	0.23	0.24	0.22	0.14	0.07	0.17	0.23	0.28	0.38	0.42	0.49	0.46	0.32
270 degrees													
Measured Erosion	1.11	1.08	1.07	1.26	NA	1.16	1.15	1.12	1.05	0.95	0.71	0.48	0.36
Measured Char	0.63	0.56	0.55	0.46	NA	0.50	0.51	0.58	0.60	0.59	0.71	0.71	0.73
Adjusted Char *	0.47	0.42	0.41	0.35	NA	0.38	0.38	0.43	0.45	0.47	0.57	0.57	0.58
Denomenator	2.81	2.69	2.66	2.95	NA	2.79	2.78	2.78	2.66	2.49	2.13	1.67	1.45
RSRM Liner Thickness	3.174	3.247	3.314	3.280	3.183	3.397	3.517	3.626	3.710	3.586	3.231	2.583	2.110
Margin of Safety	0.13	0.21	0.25	0.11	NA	0.22	0.27	0.30	0.39	0.44	0.52	0.55	0.46

Minimum margin of safety is 0.07 at station 8.00 degree 180.00
Maximum margin of safety is 0.66 at station 22.00 degree 90.00

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{2.00 \times \text{erosion} + 1.25 \times \text{adj char}^*} - 1$$

Table D-V. RSRM-28A Nose Inlet Rings (-503, -504) Char and Erosion Data

Angular Location	Stations						
0 degrees	28.0	30.0	32.0	34.0	36.0	38.0	39.0
Measured Erosion	1.27	0.99	0.91	0.88	0.91	1.03	1.05
Measured Char	0.69	0.71	0.64	0.55	0.60	0.56	0.60
Adjusted Char *	0.52	0.53	0.48	0.41	0.45	0.42	0.45
Denomenator	3.19	2.65	2.42	2.28	2.38	2.58	2.66
RSRM Liner Thickness	3.508	3.252	2.950	3.182	3.200	3.026	3.000
Margin of Safety	0.10	0.23	0.22	0.40	0.34	0.17	0.13
90 degrees							
Measured Erosion	1.11	0.91	0.91	0.87	0.89	0.99	1.02
Measured Char	0.63	0.71	0.55	0.60	0.63	0.59	0.61
Adjusted Char *	0.47	0.53	0.41	0.45	0.47	0.44	0.46
Denomenator	2.81	2.49	2.34	2.30	2.37	2.53	2.61
RSRM Liner Thickness	3.508	3.252	2.950	3.182	3.200	3.026	3.000
Margin of Safety	0.25	0.31	0.26	0.38	0.35	0.19	0.15
180 degrees							
Measured Erosion	1.07	0.90	0.93	0.83	0.86	0.93	0.97
Measured Char	0.69	0.69	0.63	0.55	0.58	0.58	0.61
Adjusted Char *	0.52	0.52	0.47	0.41	0.43	0.43	0.46
Denomenator	2.79	2.45	2.45	2.18	2.26	2.40	2.51
RSRM Liner Thickness	3.508	3.252	2.950	3.182	3.200	3.026	3.000
Margin of Safety	0.26	0.33	0.20	0.46	0.41	0.26	0.19
270 degrees							
Measured Erosion	1.12	0.97	0.95	0.88	0.92	1.02	1.08
Measured Char	0.66	0.69	0.63	0.56	0.62	0.65	0.65
Adjusted Char *	0.50	0.52	0.47	0.42	0.47	0.49	0.49
Denomenator	2.86	2.59	2.49	2.29	2.42	2.65	2.77
RSRM Liner Thickness	3.508	3.252	2.950	3.182	3.200	3.026	3.000
Margin of Safety	0.23	0.26	0.18	0.39	0.32	0.14	0.08

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{2.00 \times \text{erosion} + 1.25 \times \text{adj char *}} - 1$$

Table D-VI. RSRM-28B Nose Inlet Rings (-503, -504) Char and Erosion Data

Angular Location	Stations						
0 degrees	28.0	30.0	32.0	34.0	36.0	38.0	39.0
Measured Erosion	1.16	0.91	0.92	0.84	0.88	0.96	0.96
Measured Char	0.65	0.66	0.66	0.59	0.56	0.57	0.58
Adjusted Char *	0.49	0.50	0.50	0.44	0.42	0.43	0.43
Denomenator	2.93	2.44	2.46	2.23	2.29	2.45	2.46
RSRM Liner Thickness	3.508	3.252	2.950	3.182	3.200	3.026	3.000
Margin of Safety	0.20	0.33	0.20	0.42	0.40	0.23	0.22
90 degrees							
Measured Erosion	1.15	0.94	0.93	0.92	0.93	1.01	1.03
Measured Char	0.68	0.62	0.67	0.60	0.61	0.64	0.67
Adjusted Char *	0.51	0.47	0.50	0.45	0.46	0.48	0.50
Denomenator	2.94	2.46	2.49	2.40	2.43	2.62	2.69
RSRM Liner Thickness	3.508	3.252	2.950	3.182	3.200	3.026	3.000
Margin of Safety	0.19	0.32	0.19	0.32	0.32	0.15	0.12
180 degrees							
Measured Erosion	1.20	0.93	0.93	0.89	0.94	1.02	1.02
Measured Char	0.71	0.72	0.65	0.63	0.57	0.58	0.61
Adjusted Char *	0.53	0.54	0.49	0.47	0.43	0.43	0.46
Denomenator	3.07	2.54	2.47	2.37	2.41	2.58	2.61
RSRM Liner Thickness	3.508	3.252	2.950	3.182	3.200	3.026	3.000
Margin of Safety	0.14	0.28	0.19	0.34	0.33	0.17	0.15
270 degrees							
Measured Erosion	1.03	0.93	0.97	0.89	0.92	1.01	0.92
Measured Char	0.74	0.68	0.62	0.59	0.63	0.58	0.60
Adjusted Char *	0.56	0.51	0.47	0.44	0.47	0.43	0.45
Denomenator	2.75	2.50	2.52	2.33	2.43	2.56	2.40
RSRM Liner Thickness	3.508	3.252	2.950	3.182	3.200	3.026	3.000
Margin of Safety	0.27	0.30	0.17	0.36	0.32	0.18	0.25

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{2.00 \times \text{erosion} + 1.25 \times \text{adj char}^{*}} - 1$$

Table D-VII. RSRM-28A Nose Cap Char and Erosion Data

Angular Location	Stations												
0 degrees	1.5	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0	24.0	26.0
Measured Erosion	NA	0.41	0.47	0.52	0.57	0.59	0.71	0.79	0.90	1.13	1.79	1.97	1.42
Measured Char	NA	0.58	0.54	0.49	0.52	0.52	0.47	0.48	0.46	0.50	0.68	0.68	0.74
Adjusted Char *	NA	0.46	0.43	0.39	0.42	0.42	0.38	0.38	0.37	0.40	0.54	0.54	0.56
Denomenator	NA	1.40	1.48	1.53	1.66	1.70	1.89	2.06	2.26	2.76	4.26	4.62	3.53
RSRM Liner Thickness	1.776	2.038	2.248	2.458	2.668	2.878	3.088	3.298	3.507	4.055	4.713	4.691	3.863
Margin of Safety	NA	0.46	0.52	0.61	0.61	0.69	0.63	0.60	0.55	0.47	0.11	0.02	0.09
90 degrees													
Measured Erosion	0.29	0.36	0.40	0.46	0.48	0.54	0.59	0.67	0.78	0.97	1.49	1.73	1.21
Measured Char	0.62	0.52	0.57	0.54	0.56	0.50	0.47	0.48	0.46	0.42	0.61	0.67	0.70
Adjusted Char *	0.50	0.42	0.46	0.43	0.45	0.40	0.38	0.38	0.37	0.34	0.49	0.54	0.53
Denomenator	1.20	1.24	1.37	1.46	1.52	1.58	1.65	1.82	2.02	2.36	3.59	4.13	3.08
RSRM Liner Thickness	1.776	2.038	2.248	2.458	2.668	2.878	3.088	3.298	3.507	4.055	4.713	4.691	3.863
Margin of Safety	0.48	0.64	0.64	0.68	0.76	0.82	0.87	0.81	0.74	0.72	0.31	0.14	0.26
180 degrees													
Measured Erosion	0.31	0.36	0.39	0.47	0.48	0.58	0.62	0.71	0.78	0.96	1.39	1.63	1.10
Measured Char	0.62	0.55	0.53	0.48	0.47	0.43	0.44	0.39	0.42	0.41	0.69	0.67	0.73
Adjusted Char *	0.50	0.44	0.42	0.38	0.38	0.34	0.35	0.31	0.34	0.33	0.55	0.54	0.55
Denomenator	1.24	1.27	1.31	1.42	1.43	1.59	1.68	1.81	1.98	2.33	3.47	3.93	2.88
RSRM Liner Thickness	1.776	2.038	2.248	2.458	2.668	2.878	3.088	3.298	3.507	4.055	4.713	4.691	3.863
Margin of Safety	0.43	0.60	0.72	0.73	0.87	0.81	0.84	0.82	0.77	0.74	0.36	0.19	0.34
270 degrees													
Measured Erosion	0.31	0.41	0.43	0.48	0.54	0.59	0.59	0.74	0.85	1.06	1.55	1.75	1.23
Measured Char	0.60	0.55	0.54	0.50	0.48	0.46	0.52	0.42	0.46	0.46	0.67	0.71	0.74
Adjusted Char *	0.48	0.44	0.43	0.40	0.38	0.37	0.42	0.34	0.37	0.37	0.54	0.57	0.56
Denomenator	1.22	1.37	1.40	1.46	1.56	1.64	1.70	1.90	2.16	2.58	3.77	4.21	3.15
RSRM Liner Thickness	1.776	2.038	2.248	2.458	2.668	2.878	3.088	3.298	3.507	4.055	4.713	4.691	3.863
Margin of Safety	0.46	0.49	0.61	0.68	0.71	0.75	0.82	0.74	0.62	0.57	0.25	0.11	0.22

Minimum margin of safety is 0.02 at station 24.00 degree 0.00
Maximum margin of safety is 0.87 at station 14.00 degree 90.00

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{2.00 \times \text{erosion} + 1.25 \times \text{adj char}^{*}} - 1$$

Table D-VIII. RSRM-28B Nose Cap Char and Erosion Data

Angular Location	Stations												
0 degrees	1.5	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0	24.0	26.0
Measured Erosion	NA	0.36	0.37	0.46	0.51	0.52	0.55	0.67	0.78	0.96	1.43	1.65	1.14
Measured Char	NA	0.58	0.52	0.54	0.49	0.51	0.52	0.42	0.42	0.42	0.65	0.75	0.82
Adjusted Char *	NA	0.46	0.42	0.43	0.39	0.41	0.42	0.34	0.34	0.34	0.52	0.60	0.61
Denomenator	NA	1.30	1.26	1.46	1.51	1.55	1.62	1.76	1.98	2.34	3.51	4.05	3.05
RSRM Liner Thickness	NA	2.038	2.248	2.458	2.668	2.878	3.088	3.298	3.507	4.055	4.713	4.691	3.863
Margin of Safety	NA	0.57	0.78	0.68	0.77	0.86	0.91	0.87	0.77	0.73	0.34	0.16	0.27
90 degrees													
Measured Erosion	NA	0.43	0.45	0.49	0.49	0.58	0.66	0.74	0.78	1.08	1.68	1.83	1.31
Measured Char	NA	0.51	0.45	0.46	0.42	0.47	0.37	0.34	0.38	0.40	0.57	0.64	0.61
Adjusted Char *	NA	0.41	0.36	0.37	0.34	0.38	0.30	0.27	0.30	0.32	0.46	0.51	0.46
Denomenator	NA	1.37	1.35	1.44	1.40	1.63	1.69	1.82	1.94	2.56	3.93	4.30	3.19
RSRM Liner Thickness	NA	2.038	2.248	2.458	2.668	2.878	3.088	3.298	3.507	4.055	4.713	4.691	3.863
Margin of Safety	NA	0.49	0.67	0.71	0.91	0.77	0.83	0.81	0.81	0.58	0.20	0.09	0.21
180 degrees													
Measured Erosion	NA	0.36	0.38	0.49	0.49	0.58	0.66	0.74	0.78	1.08	1.68	1.83	1.31
Measured Char	NA	0.50	0.46	0.46	0.42	0.47	0.37	0.34	0.38	0.40	0.57	0.64	0.61
Adjusted Char *	NA	0.40	0.37	0.37	0.34	0.38	0.30	0.27	0.30	0.32	0.46	0.51	0.46
Denomenator	NA	1.22	1.22	1.44	1.40	1.63	1.69	1.82	1.94	2.56	3.93	4.30	3.19
RSRM Liner Thickness	NA	2.038	2.248	2.458	2.668	2.878	3.088	3.298	3.507	4.055	4.713	4.691	3.863
Margin of Safety	NA	0.67	0.84	0.71	0.91	0.77	0.83	0.81	0.81	0.58	0.20	0.09	0.21
270 degrees													
Measured Erosion	NA	0.30	0.33	0.41	0.42	0.47	0.48	0.61	0.68	0.86	1.35	1.57	1.10
Measured Char	NA	0.59	0.51	0.46	0.47	0.44	0.52	0.44	0.46	0.49	0.55	0.76	0.82
Adjusted Char *	NA	0.47	0.41	0.37	0.38	0.35	0.42	0.35	0.37	0.39	0.44	0.61	0.61
Denomenator	NA	1.19	1.17	1.28	1.31	1.38	1.48	1.66	1.82	2.21	3.25	3.90	2.97
RSRM Liner Thickness	NA	2.038	2.248	2.458	2.668	2.878	3.088	3.298	3.507	4.055	4.713	4.691	3.863
Margin of Safety	NA	0.71	0.92	0.92	1.04	1.09	1.09	0.99	0.93	0.83	0.45	0.20	0.30

Minimum margin of safety is 0.09 at station 24.00 degree 90.00
Maximum margin of safety is 1.09 at station 14.00 degree 270.00

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{2.00 \times \text{erosion} + 1.25 \times \text{adj char}^{*}} - 1$$

Table D-IX. RSRM-28A Cowl/OBR Char and Erosion Data

Angular Location	Stations											
0 degrees	0.3	1.0	2.0	3.0	4.0	5.0	6.0	6.8	8.0	9.0	10.0	11.3
Measured Erosion	0.30	0.36	0.40	0.43	0.44	0.38	0.30	NA	0.02	0.04	0.03	0.01
Measured Char	0.65	0.63	0.64	0.53	0.55	0.62	0.68	NA	1.07	0.94	0.91	0.93
Adjusted Char *	0.52	0.50	0.51	0.42	0.44	0.50	0.54	NA	0.86	0.75	0.73	0.74
Denomenator	1.25	1.35	1.44	1.39	1.43	1.38	1.27	NA	1.31	1.19	1.14	1.13
RSRM Liner Thickness	1.438	1.499	1.577	1.655	1.733	1.811	1.889	NA	1.600	1.674	1.687	1.703
Margin of Safety	0.15	0.11	0.10	0.19	0.21	0.31	0.49	NA	0.22	0.41	0.48	0.51
90 degrees												
Measured Erosion	0.27	0.29	0.28	0.31	0.31	0.29	0.22	NA	0.08	0.06	0.03	0.04
Measured Char	0.62	0.64	0.67	0.68	0.63	0.67	0.80	NA	0.93	0.84	0.80	0.81
Adjusted Char *	0.50	0.51	0.54	0.54	0.50	0.54	0.64	NA	0.74	0.67	0.64	0.65
Denomenator	1.16	1.22	1.23	1.30	1.25	1.25	1.29	NA	1.24	1.10	1.01	1.03
RSRM Liner Thickness	1.438	1.499	1.577	1.655	1.733	1.811	1.889	NA	1.600	1.674	1.687	1.703
Margin of Safety	0.24	0.23	0.28	0.27	0.39	0.45	0.46	NA	0.29	0.52	0.68	0.65
180 degrees												
Measured Erosion	0.30	0.35	0.35	0.32	0.32	0.30	0.24	NA	0.02	0.02	0.00	0.02
Measured Char	0.50	0.51	0.59	0.65	0.66	0.68	0.75	NA	0.95	0.82	0.78	0.88
Adjusted Char *	0.40	0.41	0.47	0.52	0.53	0.54	0.60	NA	0.76	0.66	0.62	0.70
Denomenator	1.10	1.21	1.29	1.29	1.30	1.28	1.26	NA	1.17	1.01	0.94	1.09
RSRM Liner Thickness	1.438	1.499	1.577	1.655	1.733	1.811	1.889	NA	1.600	1.674	1.687	1.703
Margin of Safety	0.31	0.24	0.22	0.28	0.33	0.41	0.50	NA	0.37	0.65	0.80	0.57
270 degrees												
Measured Erosion	0.28	0.31	0.33	0.35	0.35	0.33	0.25	NA	0.02	0.00	0.00	0.00
Measured Char	0.52	0.55	0.64	0.65	0.66	0.69	0.80	NA	0.85	0.81	0.84	0.87
Adjusted Char *	0.42	0.44	0.51	0.52	0.53	0.55	0.64	NA	0.68	0.65	0.67	0.70
Denomenator	1.08	1.17	1.30	1.35	1.36	1.35	1.34	NA	1.05	0.97	1.01	1.04
RSRM Liner Thickness	1.438	1.499	1.577	1.655	1.733	1.811	1.889	NA	1.600	1.674	1.687	1.703
Margin of Safety	0.33	0.28	0.21	0.23	0.27	0.34	0.41	NA	0.52	0.72	0.67	0.63

Minimum margin of safety is 0.10 at station 2.00 degree 0.00
Maximum margin of safety is 0.80 at station 10.00 degree 180.00

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{1.50 \times \text{erosion} + 1.50 \times \text{adj char}^{*}} - 1$$

Table D-X. RSRM-28B Cowl/OBR Char and Erosion Data

Angular Location	Stations											
0 degrees	0.3	1.0	2.0	3.0	4.0	5.0	6.0	6.8	8.0	9.0	10.0	11.3
Measured Erosion	0.23	0.29	0.33	0.35	0.34	NA	NA	NA	0.01	0.04	0.03	0.00
Measured Char	0.62	0.59	0.60	0.55	0.59	NA	NA	NA	0.92	0.82	0.78	0.88
Adjusted Char *	0.50	0.47	0.48	0.44	0.47	NA	NA	NA	0.74	0.66	0.62	0.70
Denomenator	1.08	1.17	1.26	1.25	1.27	NA	NA	NA	1.12	1.04	0.98	1.06
RSRM Liner Thickness	1.438	1.499	1.577	1.655	1.733	NA	NA	NA	1.600	1.674	1.687	1.703
Margin of Safety	0.33	0.28	0.25	0.32	0.36	NA	NA	NA	0.43	0.60	0.72	0.61
90 degrees												
Measured Erosion	0.23	0.29	0.33	0.38	0.39	NA	NA	NA	0.03	0.02	0.04	0.01
Measured Char	0.63	0.63	0.65	0.61	0.62	NA	NA	NA	0.99	0.96	0.88	0.90
Adjusted Char *	0.50	0.50	0.52	0.49	0.50	NA	NA	NA	0.79	0.77	0.70	0.72
Denomenator	1.09	1.21	1.31	1.37	1.40	NA	NA	NA	1.23	1.18	1.12	1.09
RSRM Liner Thickness	1.438	1.499	1.577	1.655	1.733	NA	NA	NA	1.600	1.674	1.687	1.703
Margin of Safety	0.32	0.24	0.20	0.21	0.24	NA	NA	NA	0.30	0.42	0.51	0.56
180 degrees												
Measured Erosion	0.23	0.24	0.29	0.29	0.29	NA	NA	NA	NA	0.06	0.04	0.04
Measured Char	0.68	0.66	0.64	0.63	0.59	NA	NA	NA	NA	0.83	0.78	0.81
Adjusted Char *	0.54	0.53	0.51	0.50	0.47	NA	NA	NA	NA	0.66	0.62	0.65
Denomenator	1.14	1.14	1.22	1.21	1.17	NA	NA	NA	NA	1.09	1.00	1.03
RSRM Liner Thickness	1.438	1.499	1.577	1.655	1.733	NA	NA	NA	1.600	1.674	1.687	1.703
Margin of Safety	0.26	0.31	0.29	0.37	0.48	NA	NA	NA	NA	0.54	0.69	0.65
270 degrees												
Measured Erosion	0.20	0.24	0.29	0.29	0.29	NA	NA	NA	NA	NA	0.03	0.04
Measured Char	0.68	0.66	0.64	0.63	0.59	NA	NA	NA	NA	NA	0.88	0.98
Adjusted Char *	0.54	0.53	0.51	0.50	0.47	NA	NA	NA	NA	NA	0.70	0.78
Denomenator	1.08	1.14	1.22	1.21	1.17	NA	NA	NA	NA	NA	1.10	1.24
RSRM Liner Thickness	1.438	1.499	1.577	1.655	1.733	NA	NA	NA	1.600	1.674	1.687	1.703
Margin of Safety	0.33	0.31	0.29	0.37	0.48	NA	NA	NA	NA	NA	0.53	0.38

Minimum margin of safety is 0.20 at station 2.00 degree 90.00
Maximum margin of safety is 0.72 at station 10.00 degree 0.00

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{1.50 \times \text{erosion} + 1.50 \times \text{adj char}^{*}} - 1$$

Table D-XI. RSRM-28A Fixed Housing Assembly Char and Erosion Data

Angular Location	Stations										
0 degrees	0.00	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.75
Measured Erosion	0.04	0.02	0.03	0.02	0.04	0.03	0.00	0.00	0.00	0.00	0.00
Measured Char	1.13	1.06	0.93	0.94	0.88	0.87	0.87	0.88	0.81	0.72	1.84
Adjusted Char *	0.90	0.85	0.74	0.75	0.70	0.70	0.70	0.70	0.65	0.58	1.47
Denomenator	1.21	1.10	0.99	0.98	0.96	0.93	0.87	0.88	0.81	0.72	1.84
RSRM Liner Thickness	3.807	2.081	1.825	1.827	1.829	1.831	1.832	1.834	1.836	2.426	3.048
Margin of Safety	2.15	0.89	0.84	0.86	0.91	0.97	1.11	1.08	1.27	2.37	0.66
90 degrees											
Measured Erosion	0.06	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA
Measured Char	1.00	0.99	0.88	0.87	0.90	0.93	0.85	0.85	0.77	NA	NA
Adjusted Char *	0.80	0.79	0.70	0.70	0.72	0.74	0.68	0.68	0.62	NA	NA
Denomenator	1.12	1.07	0.88	0.87	0.90	0.93	0.85	0.85	0.77	NA	NA
RSRM Liner Thickness	3.807	2.081	1.825	1.827	1.829	1.831	1.832	1.834	1.836	2.426	3.048
Margin of Safety	2.40	0.94	1.07	1.10	1.03	0.97	1.16	1.16	1.38	NA	NA
180 degrees											
Measured Erosion	0.00	0.04	0.02	0.03	0.00	0.00	0.00	0.00	0.00	0.00	NA
Measured Char	1.12	0.95	0.91	0.89	0.91	0.89	0.85	0.86	0.75	0.68	NA
Adjusted Char *	0.90	0.76	0.73	0.71	0.73	0.71	0.68	0.69	0.60	0.54	NA
Denomenator	1.12	1.03	0.95	0.95	0.91	0.89	0.85	0.86	0.75	0.68	NA
RSRM Liner Thickness	3.807	2.081	1.825	1.827	1.829	1.831	1.832	1.834	1.836	2.426	3.048
Margin of Safety	2.40	1.02	0.92	0.92	1.01	1.06	1.16	1.13	1.45	2.57	NA
270 degrees											
Measured Erosion	0.04	0.05	0.06	0.03	0.03	0.02	0.00	0.00	0.00	0.00	0.18
Measured Char	1.28	1.01	1.01	1.00	0.94	0.93	0.90	0.88	0.73	0.64	1.46
Adjusted Char *	1.02	0.81	0.81	0.80	0.75	0.74	0.72	0.70	0.58	0.51	1.17
Denomenator	1.36	1.11	1.13	1.06	1.00	0.97	0.90	0.88	0.73	0.64	1.82
RSRM Liner Thickness	3.807	2.081	1.825	1.827	1.829	1.831	1.832	1.834	1.836	2.426	3.048
Margin of Safety	1.80	0.87	0.62	0.72	0.83	0.89	1.04	1.08	1.52	2.79	0.67

Minimum margin of safety is 0.62 at station 2.00 degree 270.00
Maximum margin of safety is 2.79 at station 9.00 degree 270.00

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{2.00 \times \text{erosion} + 1.25 \times \text{adj char *}} - 1$$

Table D-XII. RSRM-28B Fixed Housing Assembly Char and Erosion Data

Angular Location	Stations										
0 degrees	0.00	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.75
Measured Erosion	0.10	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Measured Char	1.12	1.11	1.00	0.96	0.93	0.96	0.95	0.92	0.82	0.67	1.58
Adjusted Char *	0.90	0.89	0.80	0.77	0.74	0.77	0.76	0.74	0.66	0.54	1.26
Denomenator	1.32	1.19	1.02	0.96	0.93	0.96	0.95	0.92	0.82	0.67	1.58
RSRM Liner Thickness	3.807	2.081	1.825	1.827	1.829	1.831	1.832	1.834	1.836	2.426	3.048
Margin of Safety	1.88	0.75	0.79	0.90	0.97	0.91	0.93	0.99	1.24	2.62	0.93
90 degrees											
Measured Erosion	0.10	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Measured Char	1.08	1.11	1.02	1.04	1.03	1.03	1.00	0.89	0.71	0.75	1.83
Adjusted Char *	0.86	0.89	0.82	0.83	0.82	0.82	0.80	0.71	0.57	0.60	1.46
Denomenator	1.28	1.27	1.02	1.04	1.03	1.03	1.00	0.89	0.71	0.75	1.83
RSRM Liner Thickness	3.807	2.081	1.825	1.827	1.829	1.831	1.832	1.834	1.836	2.426	3.048
Margin of Safety	1.97	0.64	0.79	0.76	0.78	0.78	0.83	1.06	1.59	2.23	0.67
180 degrees											
Measured Erosion	0.10	0.04	0.04	0.04	0.02	0.03	0.03	0.03	0.00	0.00	0.00
Measured Char	1.00	1.00	0.92	0.90	0.91	0.88	0.89	0.84	0.85	0.78	1.79
Adjusted Char *	0.80	0.80	0.74	0.72	0.73	0.70	0.71	0.67	0.68	0.62	1.43
Denomenator	1.20	1.08	1.00	0.98	0.95	0.94	0.95	0.90	0.85	0.78	1.79
RSRM Liner Thickness	3.807	2.081	1.825	1.827	1.829	1.831	1.832	1.834	1.836	2.426	3.048
Margin of Safety	2.17	0.93	0.82	0.86	0.93	0.95	0.93	1.04	1.16	2.11	0.70
270 degrees											
Measured Erosion	0.12	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Measured Char	1.13	1.02	0.99	1.04	1.01	1.03	0.92	0.92	0.80	0.98	1.72
Adjusted Char *	0.90	0.82	0.79	0.83	0.81	0.82	0.74	0.74	0.64	0.78	1.38
Denomenator	1.37	1.08	0.99	1.04	1.01	1.03	0.92	0.92	0.80	0.98	1.72
RSRM Liner Thickness	3.807	2.081	1.825	1.827	1.829	1.831	1.832	1.834	1.836	2.426	3.048
Margin of Safety	1.78	0.93	0.84	0.76	0.81	0.78	0.99	0.99	1.29	1.48	0.77

Minimum margin of safety is 0.64 at station 1.00 degree 90.00
Maximum margin of safety is 2.62 at station 9.00 degree 0.00

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{2.00 \times \text{erosion} + 1.25 \times \text{adj char}^{*}} - 1$$

Table D-XIII. RSRM-28A Aft Exit Cone Assembly Char and Erosion Data

Angular Location	Stations												
	1.00	6.00	18.00	30.00	42.00	54.00	64.00	73.77	77.77	83.77	89.77	95.77	101.77
0 degrees													
Measured Erosion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Measured Char	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Adjusted Char *	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Denomenator	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RSRM Liner Thickness	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.095
Margin of Safety	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
18 degrees													
Measured Erosion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Measured Char	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Adjusted Char *	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Denomenator	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RSRM Liner Thickness	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.095
Margin of Safety	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
30 degrees													
Measured Erosion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Measured Char	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Adjusted Char *	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Denomenator	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RSRM Liner Thickness	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.095
Margin of Safety	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
90 degrees													
Measured Erosion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Measured Char	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Adjusted Char *	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Denomenator	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RSRM Liner Thickness	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.095
Margin of Safety	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
128 degrees													
Measured Erosion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Measured Char	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Adjusted Char *	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Denomenator	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RSRM Liner Thickness	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.095
Margin of Safety	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
180 degrees													
Measured Erosion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Measured Char	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Adjusted Char *	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Denomenator	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RSRM Liner Thickness	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.095
Margin of Safety	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table D-XIII. RSRM-28A Aft Exit Cone Assembly Char and Erosion Data (cont.)

Angular Location	Stations												
220 degrees													
Measured Erosion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Measured Char	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Adjusted Char *	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Denomenator	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RSRM Liner Thickness	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.095
Margin of Safety	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
255 degrees													
Measured Erosion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.12
Measured Char	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.55
Adjusted Char *	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.47
Denomenator	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.79
RSRM Liner Thickness	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.095
Margin of Safety	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.39
263 degrees													
Measured Erosion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.16
Measured Char	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.59
Adjusted Char *	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.50
Denomenator	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.90
RSRM Liner Thickness	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.095
Margin of Safety	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.22
270 degrees													
Measured Erosion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.15
Measured Char	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.58
Adjusted Char *	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.49
Denomenator	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.87
RSRM Liner Thickness	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.095
Margin of Safety	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26
278 degrees													
Measured Erosion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.11
Measured Char	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.64
Adjusted Char *	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.54
Denomenator	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.87
RSRM Liner Thickness	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.095
Margin of Safety	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26

Table D-XIII. RSRM-28A Aft Exit Cone Assembly Char and Erosion Data (cont.)

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Minimum margin of safety is 0.22 at station 101.77 degree 263.00
Maximum margin of safety is 0.48 at station 107.77 degree 278.00

           * Measured char adjusted to end of action time

                                minimum liner thickness
           Margin of Safety = ------------------------------------  - 1
                              1.70 X erosion + 1.25 X adj char *
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Table D-XIII. RSRM-28A Aft Exit Cone Assembly Char and Erosion Data (cont.)

Angular Location	Stations		
0 degrees	107.77	113.77	118.77
Measured Erosion	NA	0.16	NA
Measured Char	NA	0.56	NA
Adjusted Char *	NA	0.48	NA
Denomenator	NA	0.87	NA
RSRM Liner Thickness	1.131	1.160	NA
Margin of Safety	NA	0.34	NA
18 degrees			
Measured Erosion	0.17	0.18	NA
Measured Char	0.55	0.57	NA
Adjusted Char *	0.47	0.48	NA
Denomenator	0.87	0.91	NA
RSRM Liner Thickness	1.131	1.160	NA
Margin of Safety	0.29	0.27	NA
30 degrees			
Measured Erosion	0.16	0.18	NA
Measured Char	0.50	0.54	NA
Adjusted Char *	0.42	0.46	NA
Denomenator	0.80	0.88	NA
RSRM Liner Thickness	1.131	1.160	NA
Margin of Safety	0.41	0.32	NA
90 degrees			
Measured Erosion	NA	0.17	NA
Measured Char	NA	0.60	NA
Adjusted Char *	NA	0.51	NA
Denomenator	NA	0.93	NA
RSRM Liner Thickness	1.131	1.160	NA
Margin of Safety	NA	0.25	NA
128 degrees			
Measured Erosion	NA	0.12	NA
Measured Char	NA	0.60	NA
Adjusted Char *	NA	0.51	NA
Denomenator	NA	0.84	NA
RSRM Liner Thickness	1.131	1.160	NA
Margin of Safety	NA	0.38	NA
180 degrees			
Measured Erosion	0.12	0.12	NA
Measured Char	0.58	0.60	NA
Adjusted Char *	0.49	0.51	NA
Denomenator	0.82	0.84	NA
RSRM Liner Thickness	1.131	1.160	NA
Margin of Safety	0.38	0.38	NA

Table D-XIII. RSRM-28A Aft Exit Cone Assembly Char and Erosion Data (cont.)

Angular Location	Stations		
220 degrees			
Measured Erosion	0.14	0.12	NA
Measured Char	0.56	0.63	NA
Adjusted Char *	0.48	0.54	NA
Denomenator	0.83	0.87	NA
RSRM Liner Thickness	1.131	1.160	NA
Margin of Safety	0.36	0.33	NA
255 degrees			
Measured Erosion	0.15	0.15	NA
Measured Char	0.55	0.57	NA
Adjusted Char *	0.47	0.48	NA
Denomenator	0.84	0.86	NA
RSRM Liner Thickness	1.131	1.160	NA
Margin of Safety	0.35	0.35	NA
263 degrees			
Measured Erosion	0.15	0.14	NA
Measured Char	0.51	0.55	NA
Adjusted Char *	0.43	0.47	NA
Denomenator	0.80	0.82	NA
RSRM Liner Thickness	1.131	1.160	NA
Margin of Safety	0.42	0.41	NA
270 degrees			
Measured Erosion	0.16	0.16	NA
Measured Char	0.54	0.54	NA
Adjusted Char *	0.46	0.46	NA
Denomenator	0.85	0.85	NA
RSRM Liner Thickness	1.131	1.160	NA
Margin of Safety	0.34	0.37	NA
278 degrees			
Measured Erosion	0.13	0.16	NA
Measured Char	0.51	0.61	NA
Adjusted Char *	0.43	0.52	NA
Denomenator	0.76	0.92	NA
RSRM Liner Thickness	1.131	1.160	NA
Margin of Safety	0.48	0.26	NA

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{1.70 \times \text{erosion} + 1.25 \times \text{adj char}^*} - 1$$

Space Shuttle
Solid Rocket Motor
Thiokol Corporation

TWR-64216

Appendix E
Insulation Postfire Data

Final Postflight Hardware Evaluation Report RSRM-28 (STS-53)

November 1993

Prepared for:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER
MARSHALL SPACE FLIGHT CENTER, ALABAMA 35812

Contract No.	NAS8-38100
DR No.	4-23
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Thiokol CORPORATION
SPACE OPERATIONS

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List of Tables

Table E-I. RSRM-28A Nozzle-to-Case Joint Performance

DEGREE LOCATION	PREFIRE (INCHES)	POSTFIRE (INCHES)	MDD	CSF	ASF
0.0	5.625	4.265	1.360	3.6	4.1
21.6	5.612				
46.8	5.610	4.248	1.362	3.6	4.1
68.4	5.617				
90.0	5.618	4.930	0.688	7.1	8.2
111.6	5.618				
136.8	5.619	4.632	0.987	5.0	5.7
158.4	5.601				
180.0	5.621	4.333	1.288	3.8	4.4
201.6	5.624				
226.8	5.614	4.496	1.118	4.4	5.0
248.4	5.622				
270.0	5.624	4.538	1.086	4.5	5.2
291.6	5.622				
316.8	5.604	4.794	0.810	6.0	6.9
338.4	5.624				
	MEDIAN 5.619	MEDIAN 4.517	MEDIAN 1.102	MINIMUM 3.6	MINIMUM 4.1

A SAFETY FACTOR OF 2.0 IS REQUIRED

A BLANK INDICATES THAT POSTFIRE DATA COLLECTION IS NOT REQUIRED AT THAT LOCATION

Table E-II. RSRM-28A Aft Field Joint Performance

DEGREE LOCATION	PREFIRE (INCHES)	POSTFIRE (INCHES)	MDD	CSF	ASF
2.0	2.755	2.333	0.422	6.1	6.5
16.0	2.754				
30.0	2.753				
46.0	2.756	2.320	0.436	6.0	6.3
60.0	2.759				
76.0	2.753				
90.0	2.757	2.269	0.488	5.3	5.6
106.0	2.754				
120.0	2.758				
136.0	2.756	2.253	0.503	5.2	5.5
150.0	2.756				
166.0	2.754				
180.0	2.752	2.293	0.459	5.7	6.0
196.0	2.752				
210.0	2.755				
226.0	2.754	2.329	0.425	6.1	6.5
242.0	2.757				
256.0	2.754				
270.0	2.752	2.347	0.405	6.4	6.8
286.0	2.753				
300.0	2.757				
316.0	2.759	2.338	0.421	6.2	6.6
330.0	2.757				
346.0	2.754				
	MEDIAN 2.755	MEDIAN 2.325	MEDIAN 0.431	MINIMUM 5.2	MINIMUM 5.5

A SAFETY FACTOR OF 2.0 IS REQUIRED

A BLANK INDICATES THAT POSTFIRE DATA COLLECTION IS NOT REQUIRED AT THAT LOCATION

Table E-III. RSRM-28A Center Field Joint Performance

DEGREE LOCATION	PREFIRE (INCHES)	POSTFIRE (INCHES)	MDD	CSF	ASF
2.0	2.695	2.620	0.075	34.6	35.9
16.0	2.703				
30.0	2.697				
46.0	2.741	2.646	0.095	27.3	28.9
60.0	2.712				
76.0	2.741				
90.0	2.695	2.555	0.140	18.5	19.3
106.0	2.702				
120.0	2.722				
136.0	2.742	2.563	0.179	14.5	15.3
150.0	2.764				
166.0	2.710				
180.0	2.741	2.593	0.148	17.5	18.5
196.0	2.713				
210.0	2.702				
226.0	2.709	2.588	0.121	21.4	22.4
242.0	2.724				
256.0	2.713				
270.0	2.711	2.567	0.144	18.0	18.8
286.0	2.715				
300.0	2.699				
316.0	2.694	2.593	0.101	25.7	26.7
330.0	2.701				
346.0	2.712				
	MEDIAN 2.711	MEDIAN 2.591	MEDIAN 0.131	MINIMUM 14.5	MINIMUM 15.3

A SAFETY FACTOR OF 2.0 IS REQUIRED

A BLANK INDICATES THAT POSTFIRE DATA COLLECTION IS NOT REQUIRED AT THAT LOCATION

Table E-IV. RSRM-28A Forward Field Joint Performance

DEGREE LOCATION	PREFIRE (INCHES)	POSTFIRE (INCHES)	MDD	CSF	ASF
2.0	2.732	2.610	0.122	21.3	22.4
16.0	2.735				
30.0	2.729				
46.0	2.730	2.568	0.162	16.0	16.9
60.0	2.736				
76.0	2.748				
90.0	2.750	2.580	0.170	15.3	16.2
106.0	2.730				
120.0	2.728				
136.0	2.715	2.618	0.097	26.8	28.0
150.0	2.713				
166.0	2.700				
180.0	2.725	2.583	0.142	18.3	19.2
196.0	2.760				
210.0	2.727				
226.0	2.732	2.591	0.141	18.4	19.4
242.0	2.730				
256.0	2.744				
270.0	2.741	2.625	0.116	22.4	23.6
286.0	2.730				
300.0	2.728				
316.0	2.729	2.608	0.121	21.4	22.6
330.0	2.737				
346.0	2.730				
	MEDIAN 2.730	MEDIAN 2.600	MEDIAN 0.132	MINIMUM 15.3	MINIMUM 16.2

A SAFETY FACTOR OF 2.0 IS REQUIRED

A BLANK INDICATES THAT POSTFIRE DATA COLLECTION IS NOT REQUIRED AT THAT LOCATION

Table E-V. RSRM-28A Aft Dome Insulation Performance

COMPLIANCE SAFETY FACTOR (CSF)

STATION (IN)	0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	DEGREE LOCATIONS MIN.	PLANE	REQUIRED S.F.
9.3	4.07	4.06	5.11	5.11	4.17	3.54	4.64	4.53	3.54	226.8	1.5
10.7	3.48	3.68	4.22	3.78	3.80	3.32	4.01	4.02	3.32	226.8	1.5
12.0	3.57	3.69	3.79	3.42	3.97	3.44	3.98	3.95	3.42	136.8	1.5
13.1	3.55	3.59	3.58	3.19	3.87	3.29	3.49	4.04	3.19	136.8	1.5
14.4	3.39	3.57	3.56	3.21	3.91	3.40	3.86	4.10	3.21	136.8	1.5
16.0	3.57	3.35	3.57	3.20	4.08	3.07	3.82	3.55	3.07	226.8	1.5
17.3	3.77	3.29	3.70	3.34	4.43	3.00	3.95	3.35	3.00	226.8	1.5
18.5	4.26	3.82	4.35	3.92	5.04	3.31	4.46	3.99	3.31	226.8	1.5
19.5	5.05	4.57	4.88	4.99	5.57	3.72	4.33	4.26	3.72	226.8	1.5
21.3	4.39	3.85	4.31	4.34	3.88	3.95	3.74	3.83	3.74	270.0	1.5
24.3	3.31	3.03	3.51	3.47	3.50	3.07	3.18	2.92	2.92	316.8	1.5
33.0	2.82	2.74	2.88	2.89	2.90	2.66	2.67	2.74	2.66	226.8	1.5
45.0	2.79	2.63	3.31	3.14	3.19	2.72	3.27	2.87	2.63	46.8	1.5
53.0	4.20	4.31	3.37	4.40	4.17	3.91	4.96	4.25	3.37	90.0	1.5
56.0	3.83	4.71	4.21	4.10	4.60	5.05	4.54	3.87	3.83	0.0	2.0
72.0	5.08	4.44	5.00	4.71	4.28	4.38	4.64	4.34	4.28	180.0	1.5
75.0	4.96	4.37	4.90	5.71	5.33	4.63	4.60	5.08	4.37	46.8	1.5
78.0	4.46	4.01	4.15	5.23	4.44	4.02	4.16	4.16	4.01	46.8	1.5

SEGMENT MINIMUM = 2.63 AT THE 45.0 INCH STATION

ACTUAL SAFETY FACTOR (ASF)

STATION (IN)	0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	DEGREE LOCATIONS MIN.	PLANE	REQUIRED S.F.
9.3	4.37	4.29	5.52	5.58	4.57	3.85	5.04	4.88	3.85	226.8	1.5
10.7	3.72	3.99	4.50	4.12	4.16	3.63	4.36	4.32	3.63	226.8	1.5
12.0	3.84	4.04	4.07	3.75	4.37	3.79	4.36	4.27	3.75	136.8	1.5
13.1	3.83	3.94	3.86	3.52	4.30	3.62	3.94	4.35	3.52	136.8	1.5
14.4	3.57	3.86	3.77	3.48	4.26	3.64	4.15	4.32	3.48	136.8	1.5
16.0	3.82	3.72	3.86	3.54	4.58	3.37	4.17	3.85	3.37	226.8	1.5
17.3	4.14	3.77	4.15	3.74	5.09	3.39	4.42	3.75	3.39	226.8	1.5
18.5	4.76	4.42	4.94	4.41	5.87	3.78	5.06	4.52	3.78	226.8	1.5
19.5	5.71	5.32	5.66	5.69	6.52	4.33	4.96	4.93	4.33	226.8	1.5
21.3	5.03	4.45	5.01	5.02	4.57	4.59	4.33	4.48	4.33	270.0	1.5
24.3	3.74	3.50	4.04	3.97	4.05	3.57	3.69	3.41	3.41	316.8	1.5
33.0	2.98	2.97	3.09	3.14	3.12	2.90	2.89	2.93	2.89	270.0	1.5
45.0	3.13	2.93	3.60	3.43	3.53	3.14	3.59	3.13	2.93	46.8	1.5
53.0	4.67	4.74	3.74	4.90	4.68	4.47	5.40	4.75	3.74	90.0	1.5
56.0	4.57	5.54	5.01	4.97	5.54	6.07	5.40	4.60	4.57	0.0	2.0
72.0	5.26	4.63	5.20	4.99	4.51	4.54	4.82	4.43	4.43	316.8	1.5
75.0	5.16	4.63	5.19	6.09	5.64	4.96	4.84	5.33	4.63	46.8	1.5
78.0	4.87	4.40	4.67	5.80	4.94	4.48	4.65	4.56	4.40	46.8	1.5

SEGMENT MINIMUM = 2.89 AT THE 33.0 INCH STATION

Table E-V. RSRM-28A Aft Dome Insulation Performance (Cont.)

MATERIAL DECOMPOSITION DEPTH (MDD)
INCHES

STATION (IN)	0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	MEDIAN	MAX.	DESIGN M+3S
	DEGREE LOCATIONS										
9.3	1.203	1.206	0.959	0.959	1.174	1.383	1.057	1.082	1.128	1.383	2.560
10.7	1.351	1.276	1.113	1.243	1.237	1.417	1.171	1.169	1.240	1.417	2.261
12.0	1.259	1.218	1.187	1.315	1.134	1.309	1.132	1.139	1.202	1.315	2.208
13.1	1.211	1.199	1.201	1.348	1.112	1.307	1.233	1.064	1.206	1.348	2.218
14.4	1.210	1.149	1.151	1.276	1.048	1.206	1.062	1.000	1.150	1.276	2.225
16.0	1.058	1.127	1.060	1.183	0.927	1.231	0.989	1.066	1.063	1.231	1.980
17.3	0.944	1.083	0.963	1.065	0.804	1.186	0.901	1.063	1.013	1.186	1.675
18.5	0.789	0.880	0.773	0.858	0.667	1.014	0.753	0.843	0.816	1.014	1.496
19.5	0.624	0.689	0.646	0.631	0.566	0.846	0.728	0.739	0.667	0.846	1.617
21.3	0.669	0.764	0.682	0.678	0.758	0.744	0.787	0.768	0.751	0.787	1.654
24.3	0.889	0.971	0.837	0.848	0.841	0.957	0.924	1.008	0.906	1.008	1.832
33.0	1.136	1.166	1.113	1.106	1.104	1.201	1.200	1.168	1.151	1.201	1.399
45.0	0.931	0.987	0.786	0.828	0.816	0.957	0.796	0.907	0.867	0.987	1.222
53.0	0.805	0.784	1.002	0.768	0.810	0.865	0.682	0.795	0.800	1.002	1.305
56.0	0.729	0.592	0.662	0.680	0.607	0.553	0.614	0.721	0.638	0.729	1.369
72.0	0.394	0.450	0.400	0.425	0.467	0.457	0.431	0.461	0.440	0.467	0.817
75.0	0.363	0.412	0.367	0.315	0.338	0.389	0.391	0.354	0.365	0.412	0.773
78.0	0.359	0.399	0.386	0.306	0.360	0.398	0.385	0.385	0.385	0.399	0.718

MATERIAL DECOMPOSITION RATE (MDR)
MILS / SECOND

STATION (IN)	0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	AVE.	EXPOSURE TIME
	DEGREE LOCATIONS									
9.3	9.8	9.8	7.8	7.8	9.6	11.3	8.6	8.8	9.2	122.5
10.7	11.2	10.6	9.3	10.3	10.3	11.8	9.7	9.7	10.4	120.3
12.0	10.7	10.4	10.1	11.2	9.7	11.2	9.7	9.7	10.3	117.3
13.1	10.6	10.5	10.5	11.8	9.7	11.4	10.8	9.3	10.6	114.5
14.4	10.8	10.3	10.3	11.4	9.4	10.8	9.5	9.0	10.2	111.7
16.0	9.7	10.4	9.8	10.9	8.5	11.3	9.1	9.8	9.9	108.7
17.3	8.9	10.2	9.1	10.1	7.6	11.2	8.5	10.1	9.5	105.7
18.5	7.6	8.5	7.5	8.3	6.4	9.8	7.3	8.1	7.9	103.5
19.5	6.1	6.8	6.4	6.2	5.6	8.3	7.2	7.3	6.7	101.5
21.3	6.8	7.8	7.0	6.9	7.7	7.6	8.0	7.8	7.5	98.1
24.3	9.4	10.3	8.9	9.0	8.9	10.2	9.8	10.7	9.7	94.1
33.0	13.5	13.9	13.3	13.2	13.2	14.3	14.3	13.9	13.7	83.9
45.0	12.4	13.1	10.4	11.0	10.8	12.7	10.6	12.0	11.6	75.3
53.0	10.7	10.5	13.4	10.3	10.8	11.5	9.1	10.6	10.9	74.9
56.0	9.8	7.9	8.9	9.1	8.1	7.4	8.2	9.7	8.6	74.7
72.0	6.9	7.9	7.1	7.5	8.2	8.1	7.6	8.1	7.7	56.7
75.0	7.1	8.1	7.2	6.2	6.7	7.7	7.7	7.0	7.2	50.8
78.0	7.7	8.6	8.3	6.6	7.7	8.5	8.3	8.3	8.0	46.6

MOTOR ACTION TIME = 123.3 SECONDS

Table E-V. RSRM-28A Aft Dome Insulation Performance (Cont.)

PART NO. 1U76668-02
SERIAL NO. 0000022

PREFIRE MEASUREMENTS
INCHES

STATION (IN)	0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	MIN.	MEDIAN	MDT
	DEGREE LOCATIONS										
9.3	5.260	5.171	5.289	5.355	5.366	5.326	5.324	5.285	5.171	5.306	4.900
10.7	5.032	5.085	5.011	5.124	5.140	5.142	5.104	5.049	5.011	5.095	4.700
12.0	4.838	4.921	4.834	4.928	4.952	4.958	4.932	4.864	4.834	4.924	4.500
13.1	4.633	4.721	4.641	4.745	4.786	4.733	4.862	4.631	4.631	4.727	4.300
14.4	4.321	4.434	4.342	4.445	4.469	4.395	4.403	4.324	4.321	4.399	4.100
16.0	4.041	4.197	4.091	4.185	4.246	4.150	4.120	4.103	4.041	4.135	3.780
17.3	3.910	4.086	3.996	3.987	4.096	4.022	3.979	3.981	3.910	3.992	3.560
18.5	3.757	3.890	3.817	3.788	3.916	3.836	3.809	3.812	3.757	3.815	3.360
19.5	3.564	3.666	3.655	3.593	3.689	3.661	3.613	3.643	3.564	3.649	3.150
21.3	3.363	3.403	3.419	3.404	3.467	3.415	3.407	3.442	3.363	3.411	2.940
24.3	3.327	3.399	3.379	3.369	3.407	3.420	3.407	3.442	3.327	3.403	2.940
33.0	3.385	3.460	3.437	3.478	3.444	3.481	3.472	3.421	3.385	3.452	3.200
45.0	2.914	2.887	2.833	2.840	2.879	3.003	2.854	2.843	2.833	2.867	2.600
53.0	3.761	3.717	3.749	3.767	3.787	3.864	3.681	3.775	3.681	3.764	3.380
56.0	3.334	3.279	3.319	3.382	3.362	3.354	3.316	3.314	3.279	3.327	2.790
72.0	2.071	2.083	2.081	2.121	2.106	2.075	2.079	2.041	2.041	2.080	2.000
75.0	1.873	1.908	1.903	1.918	1.908	1.930	1.894	1.886	1.873	1.906	1.800
78.0	1.750	1.756	1.804	1.774	1.780	1.783	1.789	1.756	1.750	1.777	1.600

PART NO. 1U76957-03
SERIAL NO. 0000013

POSTFIRE MEASUREMENTS
INCHES

STATION (IN)	0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	MIN.	MEDIAN
	DEGREE LOCATIONS									
9.3	4.057	3.965	4.330	4.396	4.192	3.943	4.267	4.203	3.943	4.198
10.7	3.681	3.809	3.898	3.881	3.903	3.725	3.933	3.880	3.681	3.881
12.0	3.579	3.703	3.647	3.613	3.818	3.649	3.800	3.725	3.579	3.676
13.1	3.422	3.522	3.440	3.397	3.674	3.426	3.629	3.567	3.397	3.481
14.4	3.111	3.285	3.191	3.169	3.421	3.189	3.341	3.324	3.111	3.238
16.0	2.983	3.070	3.031	3.002	3.319	2.919	3.131	3.037	2.919	3.034
17.3	2.966	3.003	3.033	2.922	3.292	2.836	3.078	2.918	2.836	2.985
18.5	2.968	3.010	3.044	2.930	3.249	2.822	3.056	2.969	2.822	2.990
19.5	2.940	2.977	3.009	2.962	3.123	2.815	2.885	2.904	2.815	2.951
21.3	2.694	2.639	2.737	2.726	2.709	2.671	2.620	2.674	2.620	2.684
24.3	2.438	2.428	2.542	2.521	2.566	2.463	2.483	2.434	2.428	2.473
33.0	2.249	2.294	2.324	2.372	2.340	2.280	2.272	2.253	2.249	2.287
45.0	1.983	1.900	2.047	2.012	2.063	2.046	2.058	1.936	1.900	2.029
53.0	2.956	2.933	2.747	2.999	2.977	2.999	2.999	2.980	2.747	2.979
56.0	2.605	2.687	2.657	2.702	2.755	2.801	2.702	2.593	2.593	2.694
72.0	1.677	1.633	1.681	1.696	1.639	1.618	1.648	1.580	1.580	1.644
75.0	1.510	1.496	1.536	1.603	1.570	1.541	1.503	1.532	1.496	1.534
78.0	1.391	1.357	1.418	1.468	1.420	1.385	1.404	1.371	1.357	1.398

Table E-VI. RSRM-28A Aft Cylinder Insulation Performance

COMPLIANCE SAFETY FACTOR (CSF)

STATION (IN)	0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	DEGREE LOCATIONS MIN.	PLANE	REQUIRED S.F.
85.0	3.60	4.09	4.13	3.95	4.05	3.87	3.68	3.72	3.60	0.0	1.5
90.0	3.05	4.07	3.79	3.81	3.46	3.64	3.80	3.66	3.05	0.0	1.5
98.0	2.32	2.77	3.00	3.05	2.96	2.62	3.21	2.75	2.32	0.0	1.5
105.8	2.58	2.55	2.79	2.76	2.83	2.64	2.97	2.51	2.51	316.8	1.5
116.0	2.40	2.67	3.19	2.85	3.01	2.55	3.17	2.61	2.40	0.0	1.5
124.5	2.37	2.36	2.83	2.80	2.72	2.59	2.96	2.64	2.36	46.8	1.5
133.0	2.15	2.66	2.91	2.44	2.55	2.55	2.78	2.41	2.15	0.0	1.5
145.5	3.38	2.45	3.22	2.58	2.74	2.55	2.61	2.31	2.31	316.8	1.5
158.5	2.60	2.59	2.87	3.08	2.86	2.57	2.81	2.63	2.57	226.8	1.5
166.0	2.49	2.90	3.20	2.90	2.43	2.96	3.22	2.62	2.43	180.0	1.5
177.7	2.62	3.47	2.99	3.50	3.05	2.92	3.61	2.68	2.62	0.0	2.0
192.5	3.04	2.98	2.65	2.97	2.50	2.82	3.05	2.50	2.50	180.0	1.5
202.5	3.36	2.64	3.29	3.07	3.00	2.62	3.04	2.71	2.62	226.8	1.5
214.0	2.93	2.89	2.97	3.17	2.97	2.70	2.89	2.76	2.70	226.8	1.5
227.3	2.23	2.86	2.37	2.57	3.48	2.97	3.53	2.46	2.23	0.0	1.5
238.3	2.78	3.06	3.18	3.30	3.06	3.00	3.04	2.75	2.75	316.8	1.5
250.0	2.49	2.89	3.25	2.94	2.70	3.22	3.16	2.63	2.49	0.0	1.5
269.0	3.40	2.87	6.67	3.25	4.27	2.65	4.07	2.84	2.65	226.8	1.5
283.9	4.64	3.41	+	2.92	4.59	3.36	19.57	2.85	2.85	316.8	1.5
299.1	4.51	4.15	4.15	4.39	3.41	4.10	4.28	4.05	3.41	180.0	2.0
322.0	6.79	4.75	7.31	5.85	5.21	6.67	5.85	5.85	4.75	46.8	1.5
339.0	4.04	6.23	8.44	5.67	6.44	4.63	6.55	5.28	4.04	0.0	1.5
358.0	+	95.00	11.52	+	+	5.67	+	8.64	5.67	226.8	1.5
367.0	+	+	+	+	+	+	+	+	+	0.0	1.5
377.5	14.72	4.82	9.30	6.79	4.69	15.14	+	8.41	4.69	180.0	1.5

SEGMENT MINIMUM = 2.15 AT THE 133.0 INCH STATION
A " + " MEANS NEGLIGIBLE MDD HAS OCCURRED

Table E-VI. RSRM-28A Aft Cylinder Insulation Performance (Cont.)

ACTUAL SAFETY FACTOR (ASF)

STATION (IN)	0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	DEGREE LOCATIONS MIN.	PLANE	REQUIRED S.F.
85.0	4.18	4.73	4.79	4.81	4.64	4.47	4.25	4.39	4.18	0.0	1.5
90.0	3.53	4.56	4.26	4.46	3.83	4.04	4.23	4.06	3.53	0.0	1.5
98.0	3.08	3.49	3.81	3.84	3.69	3.33	4.01	3.44	3.08	0.0	1.5
105.8	2.76	2.67	2.95	2.89	2.95	2.77	3.10	2.64	2.64	316.8	1.5
116.0	2.55	2.77	3.31	2.95	3.10	2.68	3.32	2.70	2.55	0.0	1.5
124.5	2.59	2.54	2.96	2.90	2.84	2.77	3.10	2.74	2.54	46.8	1.5
133.0	2.69	3.18	3.39	2.95	2.98	3.03	3.29	2.88	2.69	0.0	1.5
145.5	3.49	2.54	3.37	2.65	2.82	2.62	2.65	2.37	2.37	316.8	1.5
158.5	2.74	2.70	2.99	3.19	2.97	2.72	2.87	2.72	2.70	46.8	1.5
166.0	3.10	3.37	3.80	3.51	3.10	3.57	3.84	3.12	3.10	0.0	1.5
177.7	4.00	5.18	4.61	5.24	4.59	4.36	5.45	4.03	4.00	0.0	2.0
192.5	3.68	3.52	3.33	3.55	3.15	3.35	3.56	3.00	3.00	316.8	1.5
202.5	3.41	2.70	3.36	3.15	3.08	2.67	3.08	2.75	2.67	226.8	1.5
214.0	2.97	2.92	3.07	3.22	3.02	2.73	2.90	2.81	2.73	226.8	1.5
227.3	2.80	3.37	3.09	3.13	4.19	3.63	4.29	2.98	2.80	0.0	1.5
238.3	2.85	3.16	3.27	3.39	3.18	3.16	3.18	2.83	2.83	316.8	1.5
250.0	2.64	2.96	3.38	3.02	2.80	3.35	3.21	2.73	2.64	0.0	1.5
269.0	4.05	3.34	7.96	3.75	5.11	3.17	4.93	3.44	3.17	226.8	1.5
283.9	5.24	3.64	+	3.18	5.14	3.67	20.96	3.13	3.13	316.8	1.5
299.1	7.37	6.61	6.75	7.16	5.62	6.45	6.99	6.50	5.62	180.0	2.0
322.0	7.45	5.11	7.90	6.42	5.81	7.32	6.43	6.32	5.11	46.8	1.5
339.0	4.49	6.66	9.22	6.15	7.14	5.07	7.24	5.75	4.49	0.0	1.5
358.0	+	+	12.85	+	+	6.37	+	9.57	6.37	226.8	1.5
367.0	+	+	+	+	+	+	+	+	+	0.0	1.5
377.5	18.14	6.07	11.26	8.46	6.15	16.91	+	10.02	6.07	46.8	1.5

SEGMENT MINIMUM = 2.37 AT THE 145.5 INCH STATION
A " + " MEANS NEGLIGIBLE MDD HAS OCCURRED

Table E-VI. RSRM-28A Aft Cylinder Insulation Performance (Cont.)

MATERIAL DECOMPOSITION DEPTH (MDD)
INCHES

STATION (IN)	0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	MEDIAN	MAX.	DESIGN M+3S
					DEGREE LOCATIONS						
85.0	0.361	0.318	0.315	0.329	0.321	0.336	0.353	0.349	0.332	0.361	0.618
90.0	0.415	0.311	0.334	0.332	0.366	0.348	0.333	0.346	0.340	0.415	0.576
98.0	0.490	0.410	0.378	0.372	0.384	0.433	0.354	0.413	0.397	0.490	0.582
105.8	0.418	0.423	0.387	0.391	0.382	0.409	0.364	0.431	0.400	0.431	0.559
116.0	0.437	0.393	0.329	0.368	0.349	0.411	0.331	0.402	0.381	0.437	0.527
124.5	0.434	0.437	0.364	0.368	0.378	0.398	0.348	0.390	0.384	0.437	0.522
133.0	0.456	0.368	0.337	0.402	0.385	0.385	0.353	0.407	0.385	0.456	0.516
145.5	0.275	0.379	0.289	0.361	0.340	0.365	0.357	0.402	0.359	0.402	0.493
158.5	0.338	0.340	0.307	0.286	0.308	0.343	0.313	0.334	0.324	0.343	0.491
166.0	0.341	0.293	0.266	0.293	0.350	0.287	0.264	0.324	0.293	0.350	0.466
177.7	0.382	0.288	0.334	0.286	0.328	0.343	0.277	0.373	0.331	0.382	0.452
192.5	0.257	0.262	0.294	0.263	0.312	0.277	0.256	0.312	0.270	0.312	0.400
202.5	0.217	0.277	0.222	0.238	0.243	0.279	0.240	0.269	0.242	0.279	0.376
214.0	0.239	0.242	0.236	0.221	0.236	0.259	0.242	0.254	0.240	0.259	0.351
227.3	0.291	0.227	0.274	0.253	0.187	0.219	0.184	0.264	0.240	0.291	0.317
238.3	0.227	0.206	0.198	0.191	0.206	0.210	0.207	0.229	0.207	0.229	0.331
250.0	0.221	0.190	0.169	0.187	0.204	0.171	0.174	0.209	0.189	0.221	0.285
269.0	0.147	0.174	0.075	0.154	0.117	0.189	0.123	0.176	0.151	0.189	0.297
283.9	0.097	0.132	0	0.154	0.098	0.134	0.023	0.158	0.115	0.158	0.251
299.1	0.150	0.163	0.163	0.154	0.198	0.165	0.158	0.167	0.163	0.198	0.253
322.0	0.056	0.080	0.052	0.065	0.073	0.057	0.065	0.065	0.065	0.080	0.197
339.0	0.094	0.061	0.045	0.067	0.059	0.082	0.058	0.072	0.064	0.094	0.190
358.0	0	0.004	0.033	0	0	0.067	0	0.044	0.002	0.067	0.181
367.0	0	0	0	0	0	0	0	0	0	0	0.175
377.5	0.036	0.110	0.057	0.078	0.113	0.035	0	0.063	0.060	0.113	0.237

Table E-VI. RSRM-28A Aft Cylinder Insulation Performance (Cont.)

MATERIAL DECOMPOSITION RATE (MDR)
MILS / SECOND

STATION (IN)	0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	DEGREE LOCATIONS AVE.	EXPOSURE TIME
85.0	8.0	7.0	7.0	7.3	7.1	7.4	7.8	7.7	7.4	45.2
90.0	9.3	7.0	7.5	7.4	8.2	7.8	7.5	7.8	7.8	44.6
98.0	11.2	9.4	8.7	8.5	8.8	9.9	8.1	9.5	9.3	43.6
105.8	9.8	9.9	9.0	9.1	8.9	9.6	8.5	10.1	9.4	42.8
116.0	10.4	9.4	7.8	8.8	8.3	9.8	7.9	9.6	9.0	42.0
124.5	10.6	10.7	8.9	9.0	9.2	9.7	8.5	9.5	9.5	41.0
133.0	11.5	9.2	8.5	10.1	9.7	9.7	8.9	10.2	9.7	39.8
145.5	7.3	10.0	7.6	9.6	9.0	9.7	9.4	10.6	9.2	37.8
158.5	9.3	9.4	8.5	7.9	8.5	9.5	8.6	9.2	8.9	36.2
166.0	9.5	8.2	7.4	8.2	9.8	8.0	7.4	9.1	8.4	35.8
177.7	11.1	8.4	9.7	8.3	9.5	10.0	8.1	10.8	9.5	34.4
192.5	8.2	8.4	9.4	8.4	10.0	8.9	8.2	10.0	8.9	31.2
202.5	7.3	9.3	7.4	8.0	8.2	9.4	8.1	9.0	8.3	29.8
214.0	8.5	8.6	8.4	7.9	8.4	9.3	8.6	9.1	8.6	28.0
227.3	11.2	8.7	10.5	9.7	7.2	8.4	7.1	10.2	9.1	26.0
238.3	9.3	8.4	8.1	7.8	8.4	8.6	8.5	9.4	8.6	24.4
250.0	9.7	8.3	7.4	8.2	8.9	7.5	7.6	9.2	8.4	22.8
269.0	7.4	8.8	3.8	7.8	5.9	9.5	6.2	8.9	7.3	19.8
283.9	5.7	7.8	0	9.1	5.8	7.9	1.4	9.3	5.9	17.0
299.1	8.5	9.3	9.3	8.8	11.3	9.4	9.0	9.5	9.4	17.6
322.0	4.4	6.3	4.1	5.1	5.7	4.5	5.1	5.1	5.0	12.8
339.0	7.7	5.0	3.7	5.5	4.8	6.7	4.8	5.9	5.5	12.2
358.0	0	0.4	2.9	0	0	5.9	0	3.9	1.6	11.4
367.0	0	0	0	0	0	0	0	0	0	11.0
377.5	1.8	5.4	2.8	3.8	5.5	1.7	0	3.1	3.0	20.4

MOTOR ACTION TIME = 123.3 SECONDS

Table E-VI. RSRM-28A Aft Cylinder Insulation Performance (Cont.)

PART NO. 1U76668-02
SERIAL NO. 0000022

PREFIRE MEASUREMENTS
INCHES

STATION (IN)	DEGREE LOCATIONS 0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	MIN.	MEDIAN	MDT
85.0	1.509	1.503	1.510	1.582	1.488	1.503	1.502	1.531	1.488	1.506	1.300
90.0	1.466	1.417	1.422	1.480	1.400	1.407	1.410	1.404	1.400	1.414	1.265
98.0	1.507	1.432	1.442	1.427	1.416	1.444	1.420	1.419	1.416	1.430	1.135
105.8	1.154	1.130	1.143	1.131	1.127	1.134	1.130	1.136	1.127	1.133	1.080
116.0	1.115	1.088	1.090	1.086	1.082	1.102	1.099	1.087	1.082	1.089	1.050
124.5	1.122	1.110	1.077	1.068	1.072	1.101	1.080	1.070	1.068	1.079	1.030
133.0	1.225	1.171	1.143	1.187	1.147	1.168	1.160	1.174	1.143	1.169	0.980
145.5	0.961	0.963	0.973	0.957	0.958	0.957	0.947	0.952	0.947	0.958	0.930
158.5	0.927	0.919	0.919	0.911	0.914	0.932	0.897	0.908	0.897	0.917	0.880
166.0	1.057	0.987	1.011	1.028	1.085	1.026	1.014	1.012	0.987	1.020	0.850
177.7	1.528	1.493	1.539	1.499	1.505	1.497	1.511	1.503	1.493	1.504	1.000
192.5	0.946	0.923	0.978	0.934	0.982	0.927	0.912	0.936	0.912	0.935	0.780
202.5	0.741	0.749	0.747	0.749	0.748	0.744	0.738	0.739	0.738	0.746	0.730
214.0	0.710	0.706	0.724	0.712	0.712	0.708	0.701	0.714	0.701	0.711	0.700
227.3	0.814	0.764	0.848	0.792	0.783	0.795	0.789	0.788	0.764	0.790	0.650
238.3	0.646	0.651	0.648	0.647	0.656	0.664	0.658	0.649	0.646	0.650	0.630
250.0	0.583	0.563	0.571	0.565	0.571	0.573	0.558	0.570	0.558	0.571	0.550
269.0	0.595	0.582	0.597	0.578	0.598	0.599	0.606	0.605	0.578	0.598	0.500
283.9	0.508	0.480	0.492	0.489	0.504	0.492	0.482	0.495	0.480	0.492	0.450
299.1	1.106	1.077	1.101	1.103	1.112	1.065	1.105	1.085	1.065	1.102	0.676
322.0	0.417	0.409	0.411	0.417	0.424	0.417	0.418	0.411	0.409	0.417	0.380
339.0	0.422	0.406	0.415	0.412	0.421	0.416	0.420	0.414	0.406	0.416	0.380
358.0	0.412	0.432	0.424	0.415	0.431	0.427	0.426	0.421	0.412	0.425	0.380
367.0	0.441	0.406	0.417	0.417	0.419	0.419	0.440	0.434	0.406	0.419	0.380
377.5	0.653	0.668	0.642	0.660	0.695	0.592	0.635	0.631	0.592	0.648	0.530

Table E-VI. RSRM-28A Aft Cylinder Insulation Performance (Cont.)

PART NO. 1U76957-03
SERIAL NO. 0000013

POSTFIRE MEASUREMENTS
INCHES

STATION (IN)	0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	MIN.	MEDIAN
	DEGREE LOCATIONS									
85.0	1.148	1.185	1.195	1.253	1.167	1.167	1.149	1.182	1.148	1.175
90.0	1.051	1.106	1.088	1.148	1.034	1.059	1.077	1.058	1.034	1.068
98.0	1.017	1.022	1.064	1.055	1.032	1.011	1.066	1.006	1.006	1.027
105.8	0.736	0.707	0.756	0.740	0.745	0.725	0.766	0.705	0.705	0.738
116.0	0.678	0.695	0.761	0.718	0.733	0.691	0.768	0.685	0.678	0.706
124.5	0.688	0.673	0.713	0.700	0.694	0.703	0.732	0.680	0.673	0.697
133.0	0.769	0.803	0.806	0.785	0.762	0.783	0.807	0.767	0.762	0.784
145.5	0.686	0.584	0.684	0.596	0.618	0.592	0.590	0.550	0.550	0.594
158.5	0.589	0.579	0.612	0.625	0.606	0.589	0.584	0.574	0.574	0.589
166.0	0.716	0.694	0.745	0.735	0.735	0.739	0.750	0.688	0.688	0.735
177.7	1.146	1.205	1.205	1.213	1.177	1.154	1.234	1.130	1.130	1.191
192.5	0.689	0.661	0.684	0.671	0.670	0.650	0.656	0.624	0.624	0.666
202.5	0.524	0.472	0.525	0.511	0.505	0.465	0.498	0.470	0.465	0.502
214.0	0.471	0.464	0.488	0.491	0.476	0.449	0.459	0.460	0.449	0.468
227.3	0.523	0.537	0.574	0.539	0.596	0.576	0.605	0.524	0.523	0.557
238.3	0.419	0.445	0.450	0.456	0.450	0.454	0.451	0.420	0.419	0.450
250.0	0.362	0.373	0.402	0.378	0.367	0.402	0.384	0.361	0.361	0.375
269.0	0.448	0.408	0.522	0.424	0.481	0.410	0.483	0.429	0.408	0.439
283.9	0.411	0.348	0.524	0.335	0.406	0.358	0.459	0.337	0.335	0.382
299.1	0.956	0.914	0.938	0.949	0.914	0.900	0.947	0.918	0.900	0.928
322.0	0.361	0.329	0.359	0.352	0.351	0.360	0.353	0.346	0.329	0.352
339.0	0.328	0.345	0.370	0.345	0.362	0.334	0.362	0.342	0.328	0.345
358.0	0.432	0.428	0.391	0.434	0.431	0.360	0.435	0.377	0.360	0.430
367.0	0.454	0.431	0.454	0.433	0.462	0.456	0.517	0.450	0.431	0.454
377.5	0.617	0.558	0.585	0.582	0.582	0.557	0.641	0.568	0.557	0.582

Table E-VII. RSRM-28A Aft Center Segment Insulation Performance

COMPLIANCE SAFETY FACTOR (CSF)

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MIN.	PLANE	REQUIRED S.F.
3.5	3.49	4.64	6.84	4.96	4.23	4.30	4.99	4.71	3.49	0.0	2.0
11.0	4.23	2.23	4.05	2.59	3.73	3.55	3.63	2.92	2.23	46.0	1.5
30.7	3.07	3.12	3.42	4.93	2.76	3.91	4.30	3.44	2.76	180.0	1.5
36.2	4.17	4.08	4.35	6.59	3.21	5.17	5.41	4.35	3.21	180.0	1.5
44.6	4.50	9.23	7.20	7.20	6.10	20.00	8.57	11.25	4.50	0.0	1.5
71.5	5.48	3.78	5.00	4.05	7.39	28.33	6.07	5.48	3.78	46.0	1.5
126.0	6.82	5.00	+	4.41	5.36	7.14	10.00	7.50	4.41	136.0	1.5
145.0	5.77	7.50	8.33	3.33	5.17	12.50	5.56	4.17	3.33	136.0	1.5
161.4	10.73	3.93	4.54	7.37	3.93	11.24	2.88	3.63	2.88	270.0	2.0
163.0	3.69	3.19	3.15	5.36	2.99	3.87	3.19	3.03	2.99	180.0	2.0
178.0	6.19	5.42	4.48	6.84	4.48	14.44	4.33	32.50	4.33	270.0	1.5
214.1	+	5.42	8.13	5.91	7.22	18.57	+	6.19	5.42	46.0	1.5
280.0	+	+	+	+	+	+	+	+	+	0.0	1.5
298.0	+	+	+	+	+	+	+	+	+	0.0	1.5
311.8	+	+	+	+	+	+	+	+	+	0.0	1.5

SEGMENT MINIMUM = 2.23 AT THE 11.0 INCH STATION
A " + " MEANS NEGLIGIBLE MDD HAS OCCURRED

ACTUAL SAFETY FACTOR (ASF)

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MIN.	PLANE	REQUIRED S.F.
3.5	4.48	5.74	8.21	6.27	5.40	5.42	6.25	5.93	4.48	0.0	2.0
11.0	5.17	3.03	5.09	3.50	4.78	4.46	4.97	3.74	3.03	46.0	1.5
30.7	3.41	3.39	3.77	5.64	3.11	4.24	4.81	3.84	3.11	180.0	1.5
36.2	5.63	5.35	5.86	8.79	4.35	6.74	7.28	5.81	4.35	180.0	1.5
44.6	5.05	9.36	7.60	7.32	6.39	20.50	9.00	11.50	5.05	0.0	1.5
71.5	6.13	4.27	5.44	4.57	8.00	31.67	6.43	6.03	4.27	46.0	1.5
126.0	7.18	5.17	+	4.62	5.46	7.48	10.13	7.60	4.62	136.0	1.5
145.0	6.31	7.80	8.94	3.51	5.69	13.50	6.00	4.39	3.51	136.0	1.5
161.4	25.77	9.87	11.23	18.47	8.85	26.05	7.38	8.89	7.38	270.0	2.0
163.0	8.59	7.43	7.33	12.50	6.96	9.02	7.43	7.05	6.96	180.0	2.0
178.0	9.33	8.33	6.72	10.11	6.79	22.00	6.60	48.75	6.60	270.0	1.5
214.1	+	5.79	8.69	6.14	7.44	19.57	+	6.48	5.79	46.0	1.5
280.0	+	+	+	+	+	+	+	+	+	0.0	1.5
298.0	+	+	+	+	+	+	+	+	+	0.0	1.5
311.8	+	+	+	+	+	+	+	+	+	0.0	1.5

SEGMENT MINIMUM = 3.03 AT THE 11.0 INCH STATION
A " + " MEANS NEGLIGIBLE MDD HAS OCCURRED

Table E-VII. RSRM-28A Aft Center Segment Insulation Performance (Cont.)

MATERIAL DECOMPOSITION DEPTH (MDD)
INCHES

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MEDIAN	MAX.	DESIGN M+3S
3.5	0.608	0.457	0.310	0.427	0.501	0.493	0.425	0.450	0.453	0.608	1.067
11.0	0.449	0.853<	0.469	0.733	0.510	0.535	0.524	0.651	0.530	0.853	0.829
30.7	0.252	0.248	0.226	0.157	0.280	0.198	0.180	0.225	0.225	0.280	0.484
36.2	0.144	0.147	0.138	0.091	0.187	0.116	0.111	0.138	0.138	0.187	0.318
44.6	0.080	0.039	0.050	0.050	0.059	0.018	0.042	0.032	0.046	0.080	0.090
71.5	0.031	0.045	0.034	0.042	0.023	0.006	0.028	0.031	0.031	0.045	0.086
126.0	0.022	0.030	0	0.034	0.028	0.021	0.015	0.020	0.021	0.034	0.074
145.0	0.026	0.020	0.018	0.045	0.029	0.012	0.027	0.036	0.027	0.045	0.063
161.4	0.022	0.060	0.052	0.032	0.060	0.021	0.082<	0.065	0.056	0.082	0.082
163.0	0.064	0.074	0.075	0.044	0.079	0.061	0.074	0.078	0.074	0.079	0.082
178.0	0.021	0.024	0.029	0.019	0.029	0.009	0.030	0.004	0.023	0.030	0.065
214.1	0	0.024	0.016	0.022	0.018	0.007	0	0.021	0.017	0.024	0.029
280.0	0	0	0	0	0	0	0	0	0	0	0.005
298.0	0	0	0	0	0	0	0	0	0	0	0.005
311.8	0	0	0	0	0	0	0	0	0	0	0.003

A " < " INDICATES THE PRECEDING MDD HAS EXCEEDED THE M + 3 SIGMA DESIGN CRITERIA

MATERIAL DECOMPOSITION RATE (MDR)
MILS / SECOND

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	AVE.	EXPOSURE TIME
3.5	5.4	4.1	2.8	3.8	4.5	4.4	3.8	4.0	4.1	112.1
11.0	4.6	8.7	4.8	7.5	5.2	5.5	5.4	6.7	6.1	97.5
30.7	5.3	5.2	4.7	3.3	5.9	4.2	3.8	4.7	4.6	47.6
36.2	4.4	4.5	4.2	2.8	5.7	3.6	3.4	4.2	4.1	32.6
44.6	6.7	3.3	4.2	4.2	4.9	1.5	3.5	2.7	3.9	12.0
71.5	3.0	4.4	3.3	4.1	2.3	0.6	2.7	3.0	2.9	10.2
126.0	2.5	3.4	0	3.9	3.2	2.4	1.7	2.3	2.4	8.8
145.0	3.5	2.7	2.4	6.1	3.9	1.6	3.6	4.9	3.6	7.4
161.4	2.2	6.0	5.2	3.2	6.0	2.1	8.2	6.5	4.9	10.0
163.0	6.4	7.4	7.5	4.4	7.9	6.1	7.4	7.8	6.9	10.0
178.0	3.5	4.0	4.8	3.2	4.8	1.5	5.0	0.7	3.4	6.0
214.1	0	4.0	2.7	3.7	3.0	1.2	0	3.5	2.3	6.0
280.0	0	0	0	0	0	0	0	0	0	3.4
298.0	0	0	0	0	0	0	0	0	0	2.8
311.8	0	0	0	0	0	0	0	0	0	2.0

MOTOR ACTION TIME = 123.3 SECONDS

Table E-VII. RSRM-28A Aft Center Segment Insulation Performance (Cont.)

PART NO. 1U76667-02 PREFIRE MEASUREMENTS
SERIAL NO. 0000059 INCHES

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MIN.	MEDIAN	MDT
3.5	2.723	2.623	2.546	2.679	2.706	2.674	2.655	2.669	2.546	2.671	2.120
11.0	2.323	2.585	2.389	2.563	2.437	2.387	2.603	2.434	2.323	2.436	1.900
30.7	0.859	0.841	0.851	0.886	0.870	0.840	0.866	0.863	0.840	0.861	0.774
36.2	0.811	0.787	0.809	0.800	0.814	0.782	0.808	0.802	0.782	0.805	0.600
44.6	0.404	0.365	0.380	0.366	0.377	0.369	0.378	0.368	0.365	0.373	0.360
71.5	0.190	0.192	0.185	0.192	0.184	0.190	0.180	0.187	0.180	0.189	0.170
126.0	0.158	0.155	0.158	0.157	0.153	0.157	0.152	0.152	0.152	0.156	0.150
145.0	0.164	0.156	0.161	0.158	0.165	0.162	0.162	0.158	0.156	0.162	0.150
161.4	0.567	0.592	0.584	0.591	0.531	0.547	0.605	0.578	0.531	0.581	0.236
163.0	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.236
178.0	0.196	0.200	0.195	0.192	0.197	0.198	0.198	0.195	0.192	0.197	0.130
214.1	0.133	0.139	0.139	0.135	0.134	0.137	0.137	0.136	0.133	0.137	0.130
280.0	0.093	0.106	0.098	0.102	0.094	0.114	0.092	0.136	0.092	0.100	0.090
298.0	0.115	0.113	0.099	0.110	0.097	0.109	0.117	0.096	0.096	0.109	0.090
311.8	0.114	0.095	0.107	0.104	0.109	0.105	0.104	0.104	0.095	0.105	0.090

PART NO. 1U76791-01 POSTFIRE MEASUREMENTS
SERIAL NO. 0000026 INCHES

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MIN.	MEDIAN
3.5	2.115	2.166	2.236	2.252	2.205	2.181	2.230	2.219	2.115	2.212
11.0	1.874	1.732	1.920	1.830	1.927	1.852	2.079	1.783	1.732	1.863
30.7	0.607	0.593	0.625	0.729	0.590	0.642	0.686	0.638	0.590	0.632
36.2	0.667	0.640	0.671	0.709	0.627	0.666	0.697	0.664	0.627	0.667
44.6	0.324	0.326	0.330	0.316	0.318	0.351	0.336	0.336	0.316	0.328
71.5	0.159	0.147	0.151	0.150	0.161	0.184	0.152	0.156	0.147	0.154
126.0	0.136	0.125	0.166	0.123	0.125	0.136	0.137	0.132	0.123	0.134
145.0	0.138	0.136	0.143	0.113	0.136	0.150	0.135	0.122	0.113	0.136
161.4	0.545	0.532	0.532	0.559	0.471	0.526	0.523	0.513	0.471	0.529
163.0	0.486	0.476	0.475	0.506	0.471	0.489	0.476	0.472	0.471	0.476
178.0	0.175	0.176	0.166	0.173	0.168	0.189	0.168	0.191	0.166	0.174
214.1	0.139	0.115	0.123	0.113	0.116	0.130	0.147	0.115	0.113	0.120
280.0	L	L	L	L	L	L	L	L	L	0.100
298.0	L	L	L	L	L	L	L	L	L	0.109
311.8	L	L	L	L	L	L	L	L	L	0.105

AN " L " INDICATES THAT LINER MATERIAL WAS REMAINING AT THAT LOCATION.
THE MEDIAN AND MINIMUM VALUES WERE CALCULATED USING THE PREFIRE THICKNESSES
AT THE LOCATIONS WHERE LINER MATERIAL WAS REMAINING

Table E-VIII. RSRM-28A Forward Center Segment Insulation Performance

COMPLIANCE SAFETY FACTOR (CSF)

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MIN.	PLANE	REQUIRED S.F.
3.5	12.85	23.56	15.70	12.47	13.77	13.77	16.43	12.25	12.25	316.0	2.0
11.0	17.92	17.59	10.92	15.32	17.76	8.44	5.19	9.60	5.19	270.0	1.5
30.7	5.61	5.30	6.50	5.49	5.86	5.23	6.24	6.24	5.23	226.0	1.5
36.2	7.23	6.38	7.89	6.82	15.00	6.59	6.38	7.14	6.38	270.0	1.5
44.6	15.00	24.00	18.00	22.50	+	10.29	8.37	15.65	8.37	270.0	1.5
71.5	7.73	14.17	11.33	7.39	8.95	6.54	9.44	10.00	6.54	226.0	1.5
126.0	21.43	30.00	21.43	10.71	21.43	7.89	10.71	13.64	7.89	226.0	1.5
145.0	21.43	75.00	+	21.43	+	13.64	11.54	30.00	11.54	270.0	1.5
161.4	3.15	7.15	6.94	5.13	15.73	6.38	6.21	6.94	3.15	0.0	2.0
163.0	3.42	4.82	4.21	5.49	5.24	3.58	5.49	+	3.42	0.0	2.0
178.0	21.67	+	26.00	+	+	10.00	+	+	10.00	226.0	1.5
214.1	+	26.00	+	+	+	13.00	+	+	13.00	226.0	1.5
280.0	+	+	+	+	+	+	+	+	+	0.0	1.5
298.0	+	+	+	+	+	+	+	+	+	0.0	1.5
311.8	+	+	+	+	+	+	+	+	+	0.0	1.5

SEGMENT MINIMUM = 3.15 AT THE 161.4 INCH STATION
A " + " MEANS NEGLIGIBLE MDD HAS OCCURRED

ACTUAL SAFETY FACTOR (ASF)

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MIN.	PLANE	REQUIRED S.F.
3.5	15.94	29.11	19.19	15.55	17.01	17.05	20.45	15.54	15.54	316.0	2.0
11.0	22.18	21.92	14.11	19.40	22.74	10.84	7.11	12.40	7.11	270.0	1.5
30.7	6.31	5.89	7.24	6.28	6.70	5.84	6.87	7.14	5.84	226.0	1.5
36.2	9.95	8.71	10.78	9.43	21.27	8.90	8.70	9.88	8.70	270.0	1.5
44.6	15.46	23.87	18.15	22.50	+	10.20	8.60	15.91	8.60	270.0	1.5
71.5	8.82	15.58	12.13	8.17	9.89	7.04	10.61	11.29	7.04	226.0	1.5
126.0	24.00	31.80	23.57	11.29	23.29	8.32	11.50	14.45	8.32	226.0	1.5
145.0	22.29	76.50	+	22.00	+	13.91	11.85	30.80	11.85	270.0	1.5
161.4	7.48	16.70	15.79	12.04	36.40	14.70	14.84	16.85	7.48	0.0	2.0
163.0	7.97	11.22	9.82	12.79	12.22	8.33	12.79	+	7.97	0.0	2.0
178.0	31.50	+	36.80	+	+	14.77	+	+	14.77	226.0	1.5
214.1	+	26.60	+	+	+	13.40	+	+	13.40	226.0	1.5
280.0	+	+	+	+	+	+	+	+	+	0.0	1.5
298.0	+	+	+	+	+	+	+	+	+	0.0	1.5
311.8	+	+	+	+	+	+	+	+	+	0.0	1.5

SEGMENT MINIMUM = 5.84 AT THE 30.7 INCH STATION
A " + " MEANS NEGLIGIBLE MDD HAS OCCURRED

Table E-VIII. RSRM-28A Forward Center Segment Insulation Performance (Cont.)

MATERIAL DECOMPOSITION DEPTH (MDD)
INCHES

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MEDIAN	MAX.	DESIGN M+3S
3.5	0.165	0.090	0.135	0.170	0.154	0.154	0.129	0.173	0.154	0.173	1.067
11.0	0.106	0.108	0.174	0.124	0.107	0.225	0.366	0.198	0.149	0.366	0.829
30.7	0.138	0.146	0.119	0.141	0.132	0.148	0.124	0.124	0.135	0.148	0.484
36.2	0.083	0.094	0.076	0.088	0.040	0.091	0.094	0.084	0.086	0.094	0.318
44.6	0.024	0.015	0.020	0.016	0	0.035	0.043	0.023	0.022	0.043	0.090
71.5	0.022	0.012	0.015	0.023	0.019	0.026	0.018	0.017	0.019	0.026	0.086
126.0	0.007	0.005	0.007	0.014	0.007	0.019	0.014	0.011	0.009	0.019	0.074
145.0	0.007	0.002	0	0.007	0	0.011	0.013	0.005	0.006	0.013	0.063
161.4	0.075	0.033	0.034	0.046	0.015	0.037	0.038	0.034	0.036	0.075	0.082
163.0	0.069	0.049	0.056	0.043	0.045	0.066	0.043	0	0.047	0.069	0.082
178.0	0.006	0	0.005	0	0	0.013	0	0	0	0.013	0.065
214.1	0	0.005	0	0	0	0.010	0	0	0	0.010	0.029
280.0	0	0	0	0	0	0	0	0	0	0	0.005
298.0	0	0	0	0	0	0	0	0	0	0	0.005
311.8	0	0	0	0	0	0	0	0	0	0	0.003

MATERIAL DECOMPOSITION RATE (MDR)
MILS / SECOND

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	AVE.	EXPOSURE TIME
3.5	1.5	0.8	1.2	1.5	1.4	1.4	1.2	1.5	1.3	112.1
11.0	1.1	1.1	1.8	1.3	1.1	2.3	3.7	2.0	1.8	97.7
30.7	2.9	3.0	2.5	2.9	2.8	3.1	2.6	2.6	2.8	48.0
36.2	2.5	2.8	2.3	2.7	1.2	2.7	2.8	2.5	2.4	33.2
44.6	1.9	1.2	1.6	1.3	0	2.7	3.4	1.8	1.7	12.8
71.5	2.0	1.1	1.4	2.1	1.7	2.4	1.6	1.5	1.7	11.0
126.0	0.7	0.5	0.7	1.5	0.7	2.0	1.5	1.1	1.1	9.6
145.0	0.9	0.3	0	0.9	0	1.4	1.6	0.6	0.7	8.0
161.4	6.9	3.1	3.1	4.3	1.4	3.4	3.5	3.1	3.6	10.8
163.0	6.4	4.5	5.2	4.0	4.2	6.1	4.0	0	4.3	10.8
178.0	0.8	0	0.7	0	0	1.8	0	0	0.4	7.2
214.1	0	0.7	0	0	0	1.4	0	0	0.3	7.2
280.0	0	0	0	0	0	0	0	0	0	4.2
298.0	0	0	0	0	0	0	0	0	0	4.0
311.8	0	0	0	0	0	0	0	0	0	3.4

MOTOR ACTION TIME = 123.3 SECONDS

Table E-VIII. RSRM-28A Forward Center Segment Insulation Performance (Cont.)

PART NO. 1U76667-02 PREFIRE MEASUREMENTS
SERIAL NO. 0000060 INCHES

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MIN.	MEDIAN	MDT
3.5	2.630	2.620	2.590	2.643	2.620	2.626	2.638	2.688	2.590	2.628	2.120
11.0	2.351	2.367	2.455	2.406	2.433	2.439	2.602	2.456	2.351	2.436	1.900
30.7	0.871	0.860	0.861	0.886	0.884	0.865	0.852	0.885	0.852	0.868	0.774
36.2	0.826	0.819	0.819	0.830	0.851	0.810	0.818	0.830	0.810	0.822	0.600
44.6	0.371	0.358	0.363	0.360	0.377	0.357	0.370	0.366	0.357	0.365	0.360
71.5	0.194	0.187	0.182	0.188	0.188	0.183	0.191	0.192	0.182	0.188	0.170
126.0	0.168	0.159	0.165	0.158	0.163	0.158	0.161	0.159	0.158	0.160	0.150
145.0	0.156	0.153	0.155	0.154	0.153	0.153	0.154	0.154	0.153	0.154	0.150
161.4	0.561	0.551	0.537	0.554	0.546	0.544	0.564	0.573	0.537	0.553	0.236
163.0	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.236
178.0	0.189	0.192	0.184	0.191	0.188	0.192	0.187	0.178	0.178	0.189	0.130
214.1	0.119	0.133	0.132	0.119	0.133	0.134	0.132	0.121	0.119	0.132	0.130
280.0	0.124	0.108	0.099	0.102	0.107	0.096	0.112	0.099	0.096	0.105	0.090
298.0	0.099	0.107	0.100	0.106	0.112	0.109	0.095	0.109	0.095	0.106	0.090
311.8	0.091	0.101	0.102	0.111	0.111	0.102	0.094	0.099	0.091	0.102	0.090

PART NO. 1U76791-01 POSTFIRE MEASUREMENTS
SERIAL NO. 0000027 INCHES

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MIN.	MEDIAN
3.5	2.465	2.530	2.455	2.473	2.466	2.472	2.509	2.515	2.455	2.473
11.0	2.245	2.259	2.281	2.282	2.326	2.214	2.236	2.258	2.214	2.259
30.7	0.733	0.714	0.742	0.745	0.752	0.717	0.728	0.761	0.714	0.738
36.2	0.743	0.725	0.743	0.742	0.811	0.719	0.724	0.746	0.719	0.743
44.6	0.347	0.343	0.343	0.344	0.434	0.322	0.327	0.343	0.322	0.343
71.5	0.172	0.175	0.167	0.165	0.169	0.157	0.173	0.175	0.157	0.171
126.0	0.161	0.154	0.158	0.144	0.156	0.139	0.147	0.148	0.139	0.151
145.0	0.149	0.151	0.161	0.147	0.155	0.142	0.141	0.149	0.141	0.149
161.4	0.486	0.518	0.503	0.508	0.531	0.507	0.526	0.539	0.486	0.513
163.0	0.481	0.501	0.494	0.507	0.505	0.484	0.507	L	0.481	0.503
178.0	0.183	0.192	0.179	L	L	0.179	L	L	0.179	0.185
214.1	0.126	0.128	L	L	L	0.124	L	L	0.124	0.127
280.0	L	L	L	L	L	L	L	L	L	0.105
298.0	L	L	L	L	L	L	L	L	L	0.106
311.8	L	L	L	L	L	L	L	L	L	0.102

AN " L " INDICATES THAT LINER MATERIAL WAS REMAINING AT THAT LOCATION.
THE MEDIAN AND MINIMUM VALUES WERE CALCULATED USING THE PREFIRE THICKNESSES
AT THE LOCATIONS WHERE LINER MATERIAL WAS REMAINING

Table E-IX. RSRM-28A Forward Segment Star Tip Insulation Performance

COMPLIANCE SAFETY FACTOR (CSF)

STATION (IN)	DEGREE LOCATIONS 90.0	154.0	222.0	286.0	352.0	MIN.	PLANE	REQUIRED S.F.
3.5	31.64	42.40	15.47	+	96.36	15.47	222.0	2.0
13.0	46.43	+	11.02	23.21	+	11.02	222.0	1.5
27.0	+	+	+	+	+	+	90.0	1.5
44.0	+	+	+	+	+	+	90.0	1.5
60.0	+	+	+	+	+	+	90.0	1.5
94.7	+	+	+	+	+	+	90.0	1.5
142.0	+	+	+	+	+	+	90.0	1.5
152.0	7.37	5.98	6.22	5.56	+	5.56	286.0	1.5
162.0	3.34	2.91	7.93	3.65	4.34	2.91	154.0	2.0
175.5	3.41	3.25	2.82	3.08	3.49	2.82	222.0	1.5
187.0	2.42	2.66	2.77	3.17	3.11	2.42	90.0	1.5
199.0	2.47	2.53	2.15	3.54	3.09	2.15	222.0	1.5
213.0	4.40	2.47	4.15	3.25	2.68	2.47	154.0	1.5
224.0	2.65	2.87	2.86	2.88	3.25	2.65	90.0	1.5
230.0	2.55	2.55	2.73	2.59	3.44	2.55	90.0	1.5
236.0	2.09	2.82	2.21	3.12	2.74	2.09	90.0	1.5
240.0	2.18	2.04	2.20	2.09	2.77	2.04	154.0	1.5
254.0	2.19	2.45	2.22	2.50	3.76	2.19	90.0	1.5
263.0	2.35	2.69	2.42	2.43	2.35	2.35	90.0	1.5
282.0	2.42	2.77	2.32	1.74	2.91	1.74	286.0	1.5
293.0	2.48	2.47	2.90	2.97	3.07	2.47	154.0	1.5
305.0	3.70	2.63	5.20	4.20	2.13	2.13	352.0	1.5
312.0	6.52	3.66	2.79	2.24	2.85	2.24	286.0	1.5
321.0	3.72	2.53	3.49	3.43	3.14	2.53	154.0	2.0
339.0	3.20	1.93	2.04	2.00	2.48	1.93	154.0	1.5
350.0	2.81	2.63	2.49	2.67	2.94	2.49	222.0	1.5
362.0	2.05	5.84	6.05	3.10	3.71	2.05	90.0	1.5
371.0	2.81	2.57	2.11	2.95	3.33	2.11	222.0	1.5
383.0	6.08	5.49	2.37	2.94	3.34	2.37	222.0	1.5
397.0	2.68	2.55	2.41	2.36	3.03	2.36	286.0	1.5
403.0	3.38	3.86	4.38	3.67	4.40	3.38	90.0	1.5

SEGMENT MINIMUM = 1.74 AT THE 282.0 INCH STATION
A " + " MEANS NEGLIGIBLE MDD HAS OCCURRED

ACTUAL SAFETY FACTOR (ASF)

STATION (IN)	DEGREE LOCATIONS 90.0	154.0	222.0	286.0	352.0	MIN.	PLANE
3.5	38.00	51.10	18.24	+	+	18.24	222.0
13.0	71.07	+	16.19	35.96	+	16.19	222.0
27.0	+	+	+	+	+	+	90.0
44.0	+	+	+	+	+	+	90.0
60.0	+	+	+	+	+	+	90.0
94.7	+	+	+	+	+	+	90.0
142.0	+	+	+	+	+	+	90.0
152.0	8.51	6.98	7.43	6.32	+	6.32	286.0
162.0	4.92	4.16	10.12	5.29	6.24	4.16	154.0
175.5	4.16	3.88	3.44	3.65	4.22	3.44	222.0
187.0	2.65	2.86	2.94	3.41	3.36	2.65	90.0
199.0	2.76	2.93	2.47	3.93	3.48	2.47	222.0
213.0	4.53	2.82	4.45	3.77	3.04	2.82	154.0
224.0	3.12	3.43	3.40	3.36	3.74	3.12	90.0
230.0	2.89	3.11	3.18	2.99	3.84	2.89	90.0
236.0	2.48	2.99	2.72	3.65	3.18	2.48	90.0
240.0	2.60	2.41	2.68	2.45	3.18	2.41	154.0
254.0	2.44	2.51	2.66	2.76	4.01	2.44	90.0
263.0	2.56	2.76	2.56	2.57	2.48	2.48	352.0
282.0	2.79	3.18	2.83	2.29	3.36	2.29	286.0
293.0	2.97	2.96	3.43	3.45	3.53	2.96	154.0
305.0	4.00	3.38	5.73	4.66	2.87	2.87	352.0
312.0	7.08	4.11	3.59	2.93	3.52	2.93	286.0
321.0	4.19	3.06	3.92	4.03	3.69	3.06	154.0
339.0	3.40	2.37	2.48	2.38	2.73	2.37	154.0
350.0	3.19	2.98	2.96	3.21	3.41	2.96	222.0
362.0	2.58	5.78	6.12	3.67	4.21	2.58	90.0
371.0	3.44	3.19	2.66	3.70	3.96	2.66	222.0
383.0	6.13	5.53	2.97	3.52	3.93	2.97	222.0
397.0	3.18	3.14	3.10	2.96	3.84	2.96	286.0
403.0	3.81	4.27	4.92	4.21	5.09	3.81	90.0

SEGMENT MINIMUM = 2.29 AT THE 282.0 INCH STATION

Table E-IX. RSRM-28A Forward Segment Star Tip Insulation Performance (Cont.)

MATERIAL DECOMPOSITION DEPTH (MDD)
INCHES

STATION (IN)	DEGREE LOCATIONS 90.0	154.0	222.0	286.0	352.0	MEDIAN	MAX.	DESIGN M+3S
3.5	0.067	0.050	0.137<	0.007	0.022	0.050	0.137	0.103
13.0	0.014	0	0.059	0.028	0	0.014	0.059	0.101
27.0	0	0	0	0	0	0	0	0.044
44.0	0	0	0	0	0	0	0	0.015
60.0	0	0	0	0	0	0	0	0.012
94.7	0	0	0	0	0	0	0	0.004
142.0	0	0	0	0	0	0	0	0.019
152.0	0.043	0.053	0.051	0.057	0	0.051	0.057	0.123
162.0	0.164	0.188	0.069	0.150	0.126	0.150	0.188	0.227
175.5	0.177	0.186	0.214	0.196	0.173	0.186	0.214	0.324
187.0	0.264	0.241	0.231	0.202	0.206	0.231	0.264	0.398
199.0	0.276	0.270	0.318	0.193	0.221	0.270	0.318	0.427
213.0	0.154	0.274	0.163	0.208	0.253	0.208	0.274	0.423
224.0	0.255	0.236	0.237	0.235	0.208	0.236	0.255	0.422
230.0	0.266	0.265	0.248	0.261	0.197	0.261	0.266	0.375
236.0	0.277	0.205	0.261	0.185	0.211	0.211	0.277	0.327
240.0	0.263	0.282	0.261	0.275	0.207	0.263	0.282	0.342
254.0	0.259	0.232	0.256	0.227	0.151	0.232	0.259	0.318
263.0	0.242	0.211	0.235	0.234	0.242	0.235	0.242	0.334
282.0	0.235	0.205	0.245	0.326	0.195	0.235	0.326	0.349
293.0	0.220	0.221	0.188	0.184	0.178	0.188	0.221	0.330
305.0	0.142	0.200	0.101	0.125	0.246	0.142	0.246	0.309
312.0	0.083	0.148	0.194	0.242	0.190	0.190	0.242	0.308
321.0	0.247	0.363	0.263	0.268	0.292	0.268	0.363	0.434
339.0	0.172	0.286	0.270	0.276	0.222	0.270	0.286	0.319
350.0	0.186	0.199	0.210	0.196	0.178	0.196	0.210	0.300
362.0	0.254	0.089	0.086	0.168	0.140	0.140	0.254	0.285
371.0	0.185	0.202	0.246	0.176	0.156	0.185	0.246	0.304
383.0	0.084	0.093	0.216	0.174	0.153	0.153	0.216	0.295
397.0	0.188	0.197	0.209	0.213	0.166	0.197	0.213	0.287
403.0	0.281	0.246	0.217	0.259	0.216	0.246	0.281	0.287

MATERIAL DECOMPOSITION RATE (MDR)
MILS / SECOND

STATION (IN)	DEGREE LOCATIONS 90.0	154.0	222.0	286.0	352.0	AVE.	EXPOSURE TIME
3.5	1.9	1.5	4.0	0.2	0.6	1.6	34.4
13.0	0.7	0	3.0	1.4	0	1.0	19.4
27.0	0	0	0	0	0	0	4.8
44.0	0	0	0	0	0	0	3.0
60.0	0	0	0	0	0	0	1.4
94.7	0	0	0	0	0	0	0.8
142.0	0	0	0	0	0	0	1.0
152.0	1.3	1.6	1.6	1.7	0	1.3	32.6
162.0	2.8	3.2	1.2	2.6	2.2	2.4	58.1
175.5	2.0	2.1	2.4	2.2	1.9	2.1	89.3
187.0	2.6	2.4	2.3	2.0	2.0	2.2	102.1
199.0	2.7	2.6	3.1	1.9	2.2	2.5	102.1
213.0	1.5	2.7	1.6	2.0	2.5	2.1	102.1
224.0	2.5	2.3	2.3	2.3	2.0	2.3	102.1
230.0	2.6	2.6	2.4	2.6	1.9	2.4	102.1
236.0	2.7	2.0	2.6	1.8	2.1	2.2	102.1
240.0	2.6	2.8	2.6	2.7	2.0	2.5	102.1
254.0	2.5	2.3	2.5	2.2	1.5	2.2	102.1
263.0	2.4	2.1	2.3	2.3	2.4	2.3	102.1
282.0	2.3	2.0	2.4	3.2	1.9	2.4	102.1
293.0	2.2	2.2	1.8	1.8	1.7	1.9	102.1
305.0	1.4	2.0	1.0	1.2	2.4	1.6	102.1
312.0	0.8	1.4	1.9	2.4	1.9	1.7	102.1
321.0	2.4	3.5	2.5	2.6	2.8	2.7	104.3
339.0	1.7	2.8	2.7	2.7	2.2	2.4	100.7
350.0	1.9	2.0	2.1	2.0	1.8	1.9	100.5
362.0	2.6	0.9	0.9	1.7	1.4	1.5	99.5
371.0	1.9	2.1	2.6	1.9	1.6	2.0	95.1
383.0	0.9	1.0	2.2	1.8	1.6	1.5	96.3
397.0	1.9	2.0	2.1	2.1	1.7	1.9	100.5
403.0	2.3	2.0	1.8	2.1	1.8	2.0	123.3

MOTOR ACTION TIME = 123.3 SECONDS

A " < " INDICATES THE PRECEDING MDD HAS EXCEEDED THE M + 3 SIGMA DESIGN CRITERIA

Table E-IX. RSRM-28A Forward Segment Star Tip Insulation Performance (Cont.)

PREFIRE MEASUREMENTS
INCHES

PART NO. 1U76666-02
SERIAL NO. 0000031

STATION (IN)	DEGREE LOCATIONS 90.0	154.0	222.0	286.0	352.0	MIN.	MEDIAN	MDT
3.5	2.546	2.555	2.499	2.597	2.608	2.499	2.555	2.120
13.0	0.995	0.885	0.955	1.007	0.998	0.885	0.995	0.650
27.0	0.832	0.604	0.588	0.618	0.624	0.588	0.618	0.450
44.0	0.304	0.296	0.297	0.295	0.294	0.294	0.296	0.250
60.0	0.146	0.143	0.143	0.144	0.149	0.143	0.144	0.100
94.7	0.093	0.108	0.095	0.094	0.100	0.093	0.095	0.090
142.0	0.152	0.155	0.158	0.154	0.160	0.152	0.155	0.113
152.0	0.366	0.370	0.379	0.360	0.394	0.360	0.370	0.317
162.0	0.807	0.782	0.698	0.793	0.786	0.698	0.786	0.547
175.5	0.736	0.722	0.736	0.716	0.730	0.716	0.730	0.604
187.0	0.699	0.689	0.679	0.688	0.692	0.679	0.689	0.640
199.0	0.761	0.790	0.787	0.758	0.769	0.758	0.769	0.683
213.0	0.697	0.772	0.725	0.785	0.770	0.697	0.770	0.677
224.0	0.795	0.809	0.806	0.789	0.777	0.777	0.795	0.677
230.0	0.769	0.824	0.788	0.780	0.756	0.756	0.780	0.677
236.0	0.688	0.612	0.711	0.676	0.670	0.612	0.676	0.578
240.0	0.685	0.679	0.700	0.675	0.658	0.658	0.679	0.574
254.0	0.633	0.583	0.682	0.627	0.606	0.583	0.627	0.568
263.0	0.619	0.582	0.602	0.601	0.601	0.582	0.601	0.568
282.0	0.656	0.651	0.694	0.745	0.655	0.651	0.656	0.568
293.0	0.653	0.655	0.644	0.634	0.628	0.628	0.644	0.546
305.0	0.568	0.676	0.579	0.582	0.705	0.568	0.582	0.525
312.0	0.588	0.609	0.697	0.710	0.669	0.588	0.669	0.541
321.0	1.034	1.111	1.032	1.081	1.077	1.032	1.077	0.918
339.0	0.585	0.678	0.670	0.658	0.605	0.585	0.658	0.551
350.0	0.593	0.593	0.621	0.630	0.607	0.593	0.607	0.523
362.0	0.655	0.514	0.526	0.616	0.589	0.514	0.589	0.520
371.0	0.637	0.644	0.654	0.651	0.617	0.617	0.644	0.520
383.0	0.515	0.514	0.641	0.613	0.602	0.514	0.602	0.511
397.0	0.597	0.619	0.648	0.630	0.637	0.597	0.630	0.503
403.0	1.072	1.050	1.068	1.090	1.099	1.050	1.072	0.950

POSTFIRE MEASUREMENTS
INCHES

PART NO. 1U76790-05
SERIAL NO. 0000013

STATION (IN)	DEGREE LOCATIONS 90.0	154.0	222.0	286.0	352.0	MIN.	MEDIAN
3.5	2.479	2.505	2.362	2.590	2.586	2.362	2.505
13.0	0.981	0.908	0.896	0.979	1.020	0.896	0.979
27.0	L	L	L	L	L	L	0.618
44.0	L	L	L	L	L	L	0.296
60.0	L	L	L	L	L	L	0.144
94.7	L	L	L	L	L	L	0.095
142.0	L	L	L	L	L	L	0.155
152.0	0.323	0.317	0.328	0.303	L	0.303	0.323
162.0	0.643	0.594	0.629	0.643	0.660	0.594	0.643
175.5	0.559	0.536	0.522	0.520	0.557	0.520	0.536
187.0	0.435	0.448	0.448	0.486	0.486	0.435	0.448
199.0	0.485	0.520	0.469	0.565	0.548	0.469	0.520
213.0	0.543	0.498	0.562	0.577	0.517	0.498	0.543
224.0	0.540	0.573	0.569	0.554	0.569	0.540	0.569
230.0	0.503	0.559	0.540	0.519	0.559	0.503	0.540
236.0	0.411	0.407	0.450	0.491	0.459	0.407	0.450
240.0	0.422	0.397	0.439	0.400	0.451	0.397	0.422
254.0	0.374	0.351	0.426	0.400	0.455	0.351	0.400
263.0	0.377	0.371	0.367	0.367	0.359	0.359	0.367
282.0	0.421	0.446	0.449	0.419	0.460	0.419	0.446
293.0	0.433	0.434	0.456	0.450	0.450	0.433	0.450
305.0	0.426	0.476	0.478	0.457	0.459	0.426	0.459
312.0	0.505	0.461	0.503	0.468	0.479	0.461	0.479
321.0	0.787	0.748	0.769	0.813	0.785	0.748	0.785
339.0	0.413	0.392	0.400	0.382	0.383	0.382	0.392
350.0	0.407	0.394	0.411	0.434	0.429	0.394	0.411
362.0	0.401	0.425	0.440	0.448	0.449	0.401	0.440
371.0	0.452	0.442	0.408	0.475	0.461	0.408	0.452
383.0	0.431	0.421	0.425	0.439	0.449	0.421	0.431
397.0	0.409	0.422	0.439	0.417	0.471	0.409	0.422
403.0	0.791	0.804	0.851	0.831	0.883	0.791	0.831

AN " L " INDICATES THAT LINER MATERIAL WAS REMAINING AT THAT LOCATION.
THE MEDIAN AND MINIMUM VALUES WERE CALCULATED USING THE PREFIRE THICKNESSES
AT THE LOCATIONS WHERE LINER MATERIAL WAS REMAINING

Table E-X. RSRM-28A Forward Segment Non-Star Tip Insulation Performance

COMPLIANCE SAFETY FACTOR (CSF)

STATION (IN)	DEGREE LOCATIONS 74.0	140.0	206.0	270.0	336.0	MIN.	PLANE	REQUIRED S.F.
3.5	64.24	47.11	33.65	34.19	34.19	33.65	206.0	2.0
13.0	12.04	16.67	27.08	6.19	22.41	6.19	270.0	1.5
27.0	+	+	+	+	+	+	74.0	1.5
44.0	+	+	+	+	+	+	74.0	1.5
60.0	+	+	+	+	+	+	74.0	1.5
94.7	+	+	+	+	+	+	74.0	1.5
142.0	+	+	+	+	+	+	74.0	1.5
152.0	11.32	+	6.10	+	+	6.10	206.0	1.5
162.0	4.93	4.88	3.06	5.21	3.02	3.02	336.0	2.0
175.5	4.17	3.30	3.82	3.95	4.87	3.30	140.0	1.5
187.0	4.81	3.70	3.35	3.50	4.81	3.35	206.0	1.5
199.0	3.54	3.56	3.48	3.59	5.69	3.48	206.0	1.5
213.0	3.91	7.36	4.54	3.85	5.29	3.85	270.0	1.5
224.0	4.03	5.01	3.87	3.96	4.34	3.87	206.0	1.5
230.0	4.01	3.76	3.68	4.48	5.60	3.68	206.0	1.5
236.0	3.48	3.85	3.75	3.03	3.68	3.03	270.0	1.5
240.0	3.73	3.59	3.83	3.07	4.07	3.07	270.0	1.5
254.0	3.23	3.89	2.85	2.97	4.21	2.85	206.0	1.5
263.0	3.79	3.16	3.17	4.34	4.98	3.16	140.0	1.5
282.0	3.05	3.84	4.40	3.01	4.34	3.01	270.0	1.5
293.0	3.37	3.23	4.67	2.65	3.59	2.65	270.0	1.5
305.0	3.98	2.85	2.60	3.78	4.01	2.60	206.0	1.5
312.0	3.56	9.49	3.24	6.36	3.32	3.24	206.0	1.5
321.0	5.96	5.02	7.65	3.92	5.37	3.92	270.0	2.0
339.0	4.14	3.53	2.53	3.85	3.15	2.53	206.0	1.5
350.0	3.44	3.63	2.39	2.60	3.90	2.39	206.0	1.5
362.0	3.49	6.19	2.64	2.54	3.01	2.54	270.0	1.5
371.0	3.38	9.12	2.77	1.10<	7.54	1.10	270.0	1.5
383.0	2.59	5.68	2.89	2.94	3.25	2.59	74.0	1.5
397.0	1.82	2.61	2.44	2.20	3.29	1.82	74.0	1.5
403.0	3.71	3.35	4.61	3.33	4.34	3.33	270.0	1.5

SEGMENT MINIMUM = 1.10 AT THE 371.0 INCH STATION

ACTUAL SAFETY FACTOR (ASF)

STATION (IN)	DEGREE LOCATIONS 74.0	140.0	206.0	270.0	336.0	MIN.	PLANE
3.5	78.88	58.51	40.89	42.82	42.24	40.89	206.0
13.0	17.33	23.79	40.17	10.08	33.72	10.08	270.0
27.0	+	+	+	+	+	+	74.0
44.0	+	+	+	+	+	+	74.0
60.0	+	+	+	+	+	+	74.0
94.7	+	+	+	+	+	+	74.0
142.0	+	+	+	+	+	+	74.0
152.0	14.68	+	7.83	+	+	7.83	206.0
162.0	7.09	7.00	4.47	7.39	4.69	4.47	206.0
175.5	5.19	4.14	5.04	4.89	6.18	4.14	140.0
187.0	5.08	3.90	3.66	3.85	5.11	3.66	206.0
199.0	4.03	3.99	3.92	4.19	6.45	3.92	206.0
213.0	4.59	7.57	4.75	4.67	6.13	4.59	74.0
224.0	4.99	5.76	4.59	4.84	5.42	4.59	206.0
230.0	4.72	4.37	4.30	5.11	6.31	4.30	206.0
236.0	4.16	4.47	4.36	3.94	4.39	3.94	270.0
240.0	4.38	4.26	4.53	3.85	4.68	3.85	270.0
254.0	3.65	4.38	3.42	3.51	4.61	3.42	206.0
263.0	4.11	3.59	3.60	4.63	5.18	3.59	140.0
282.0	3.62	4.47	5.11	3.77	5.08	3.62	74.0
293.0	3.99	3.91	5.38	3.32	4.20	3.32	270.0
305.0	5.03	3.92	3.53	4.95	5.16	3.53	206.0
312.0	4.58	10.72	4.13	7.49	4.19	4.13	206.0
321.0	6.88	5.77	8.65	4.62	6.35	4.62	270.0
339.0	4.23	4.03	2.82	4.25	3.74	2.82	206.0
350.0	3.84	4.09	2.88	3.08	4.60	2.88	206.0
362.0	3.87	6.02	3.20	3.24	3.61	3.20	206.0
371.0	3.94	9.14	3.32	2.00	8.96	2.00	270.0
383.0	3.20	5.63	3.44	3.45	3.92	3.20	74.0
397.0	2.52	3.20	3.11	2.94	3.93	2.52	74.0
403.0	4.18	3.89	5.16	3.89	4.97	3.89	270.0

SEGMENT MINIMUM = 2.00 AT THE 371.0 INCH STATION

A " < " INDICATES THE PRECEDING SAFETY FACTOR HAS VIOLATED THE MINIMUM SAFETY FACTOR REQUIREMENT
A " + " MEANS NEGLIGIBLE MDD HAS OCCURRED

Table E-X. RSRM-28A Forward Segment Non-Star Tip Insulation Performance (Cont.)

MATERIAL DECOMPOSITION DEPTH (MDD)
INCHES

STATION (IN)	DEGREE LOCATIONS 74.0	140.0	206.0	270.0	336.0	MEDIAN	MAX.	DESIGN M+3S
3.5	0.033	0.045	0.063	0.062	0.062	0.062	0.063	0.103
13.0	0.054	0.039	0.024	0.105<	0.029	0.039	0.105	0.101
27.0	0	0	0	0	0	0	0	0.044
44.0	0	0	0	0	0	0	0	0.015
60.0	0	0	0	0	0	0	0	0.012
94.7	0	0	0	0	0	0	0	0.004
142.0	0	0	0	0	0	0	0	0.019
152.0	0.028	0	0.052	0.001	0	0.001	0.052	0.123
162.0	0.111	0.112	0.179	0.105	0.181	0.112	0.181	0.227
175.5	0.145	0.183	0.158	0.153	0.124	0.153	0.183	0.324
187.0	0.133	0.173	0.191	0.183	0.133	0.173	0.191	0.398
199.0	0.193	0.192	0.196	0.190	0.120	0.192	0.196	0.427
213.0	0.173	0.092	0.149	0.176	0.128	0.149	0.176	0.423
224.0	0.168	0.135	0.175	0.171	0.156	0.168	0.175	0.422
230.0	0.169	0.180	0.184	0.151	0.121	0.169	0.184	0.375
236.0	0.166	0.150	0.154	0.191	0.157	0.157	0.191	0.327
240.0	0.154	0.160	0.150	0.187	0.141	0.154	0.187	0.342
254.0	0.176	0.146	0.199	0.191	0.135	0.176	0.199	0.318
263.0	0.150	0.180	0.179	0.131	0.114	0.150	0.180	0.334
282.0	0.186	0.148	0.129	0.189	0.131	0.148	0.189	0.349
293.0	0.162	0.169	0.117	0.206	0.152	0.162	0.206	0.330
305.0	0.132	0.184	0.202	0.139	0.131	0.139	0.202	0.309
312.0	0.152	0.057	0.167	0.085	0.163	0.152	0.167	0.308
321.0	0.154	0.183	0.120	0.234	0.171	0.171	0.234	0.434
339.0	0.133	0.156	0.218	0.143	0.175	0.156	0.218	0.319
350.0	0.152	0.144	0.219	0.201	0.134	0.152	0.219	0.300
362.0	0.149	0.084	0.197	0.205	0.173	0.173	0.205	0.285
371.0	0.154	0.057	0.188	0.471<	0.069	0.154	0.471	0.304
383.0	0.197	0.090	0.177	0.174	0.157	0.174	0.197	0.295
397.0	0.276	0.193	0.206	0.229	0.153	0.206	0.276	0.287
403.0	0.256	0.284	0.206	0.285	0.219	0.256	0.285	0.287

MATERIAL DECOMPOSITION RATE (MDR)
MILS / SECOND

STATION (IN)	DEGREE LOCATIONS 74.0	140.0	206.0	270.0	336.0	AVE.	EXPOSURE TIME
3.5	1.0	1.3	1.8	1.8	1.8	1.5	34.4
13.0	2.8	2.0	1.2	5.4	1.5	2.6	19.4
27.0	0	0	0	0	0	0	4.8
44.0	0	0	0	0	0	0	3.0
60.0	0	0	0	0	0	0	1.4
94.7	0	0	0	0	0	0	0.8
142.0	0	0	0	0	0	0	1.0
152.0	1.3	0	2.5	0	0	0.8	20.8
162.0	2.5	2.5	4.0	2.4	4.1	3.1	44.4
175.5	2.1	2.7	2.3	2.2	1.8	2.2	68.5
187.0	2.0	2.6	2.9	2.7	2.0	2.4	66.7
199.0	2.9	2.9	2.9	2.8	1.8	2.7	66.7
213.0	2.6	1.4	2.2	2.6	1.9	2.2	66.7
224.0	2.5	2.0	2.6	2.6	2.3	2.4	66.7
230.0	2.5	2.7	2.8	2.3	1.8	2.4	66.7
236.0	2.5	2.2	2.3	2.9	2.4	2.5	66.7
240.0	2.3	2.4	2.2	2.8	2.1	2.4	66.7
254.0	2.6	2.2	3.0	2.9	2.0	2.5	66.7
263.0	2.2	2.7	2.7	2.0	1.7	2.3	66.7
282.0	2.8	2.2	1.9	2.8	2.0	2.3	66.7
293.0	2.4	2.5	1.8	3.1	2.3	2.4	66.7
305.0	2.0	2.8	3.0	2.1	2.0	2.4	66.7
312.0	2.3	0.9	2.5	1.3	2.4	1.9	66.7
321.0	2.2	2.6	1.7	3.3	2.4	2.4	71.1
339.0	1.8	2.1	3.0	2.0	2.4	2.3	73.1
350.0	2.0	1.9	2.8	2.6	1.7	2.2	76.9
362.0	1.8	1.0	2.4	2.5	2.1	2.0	81.9
371.0	1.9	0.7	2.3	5.7	0.8	2.3	82.3
383.0	2.2	1.0	2.0	1.9	1.8	1.8	89.7
397.0	2.8	2.0	2.1	2.3	1.6	2.2	97.9
403.0	2.1	2.3	1.7	2.3	1.8	2.0	123.3

MOTOR ACTION TIME = 123.3 SECONDS

A " < " INDICATES THE PRECEDING MDD HAS EXCEEDED THE M + 3 SIGMA DESIGN CRITERIA

Table E-X. RSRM-28A Forward Segment Non-Star Tip Insulation Performance (Cont.)

PREFIRE MEASUREMENTS INCHES — PART NO. 1U76666-02, SERIAL NO. 0000031

STATION (IN)	DEGREE LOCATIONS 74.0	140.0	206.0	270.0	336.0	MIN.	MEDIAN	MDT
3.5	2.603	2.633	2.576	2.655	2.619	2.576	2.619	2.120
13.0	0.936	0.928	0.964	1.058	0.978	0.928	0.964	0.650
27.0	0.604	0.620	0.591	0.612	0.597	0.591	0.604	0.450
44.0	0.303	0.296	0.293	0.301	0.295	0.293	0.296	0.250
60.0	0.145	0.138	0.138	0.153	0.145	0.138	0.145	0.100
94.7	0.090	0.094	0.095	0.112	0.110	0.090	0.095	0.090
142.0	0.152	0.151	0.156	0.160	0.158	0.151	0.156	0.113
152.0	0.411	0.383	0.407	0.379	0.393	0.379	0.393	0.317
162.0	0.787	0.784	0.801	0.776	0.848	0.776	0.787	0.547
175.5	0.752	0.757	0.796	0.748	0.766	0.748	0.757	0.604
187.0	0.675	0.674	0.700	0.704	0.679	0.674	0.679	0.640
199.0	0.777	0.767	0.768	0.796	0.774	0.767	0.774	0.683
213.0	0.794	0.696	0.708	0.822	0.785	0.696	0.785	0.677
224.0	0.838	0.778	0.804	0.827	0.846	0.778	0.827	0.677
230.0	0.797	0.787	0.791	0.771	0.764	0.764	0.787	0.677
236.0	0.691	0.671	0.672	0.752	0.689	0.671	0.689	0.578
240.0	0.675	0.681	0.680	0.720	0.660	0.660	0.680	0.574
254.0	0.642	0.639	0.680	0.671	0.623	0.623	0.642	0.568
263.0	0.617	0.646	0.644	0.606	0.590	0.590	0.617	0.568
282.0	0.674	0.662	0.659	0.713	0.665	0.659	0.665	0.568
293.0	0.647	0.660	0.630	0.684	0.639	0.630	0.647	0.546
305.0	0.664	0.721	0.714	0.688	0.676	0.664	0.688	0.525
312.0	0.696	0.611	0.690	0.637	0.683	0.611	0.683	0.541
321.0	1.059	1.055	1.038	1.080	1.085	1.038	1.059	0.918
339.0	0.563	0.629	0.614	0.608	0.655	0.563	0.614	0.551
350.0	0.584	0.589	0.630	0.619	0.616	0.584	0.616	0.523
362.0	0.577	0.506	0.631	0.665	0.624	0.506	0.624	0.520
371.0	0.606	0.521	0.625	0.941	0.618	0.521	0.618	0.520
383.0	0.631	0.507	0.609	0.600	0.615	0.507	0.609	0.511
397.0	0.696	0.617	0.640	0.673	0.601	0.601	0.640	0.503
403.0	1.070	1.106	1.063	1.108	1.088	1.063	1.088	0.950

POSTFIRE MEASUREMENTS INCHES — PART NO. 1U76790-05, SERIAL NO. 0000013

STATION (IN)	DEGREE LOCATIONS 74.0	140.0	206.0	270.0	336.0	MIN.	MEDIAN
3.5	2.570	2.588	2.513	2.593	2.557	2.513	2.570
13.0	0.882	0.889	0.940	0.953	0.949	0.882	0.940
27.0	L	L	L	L	L	L	0.604
44.0	L	L	L	L	L	L	0.296
60.0	L	L	L	L	L	L	0.145
94.7	L	L	L	L	L	L	0.095
142.0	L	L	L	L	L	L	0.156
152.0	0.383	L	0.355	0.378	L	0.355	0.383
162.0	0.676	0.672	0.622	0.671	0.667	0.622	0.671
175.5	0.607	0.574	0.638	0.595	0.642	0.574	0.607
187.0	0.542	0.501	0.509	0.521	0.546	0.501	0.521
199.0	0.584	0.575	0.572	0.606	0.654	0.572	0.584
213.0	0.621	0.604	0.559	0.646	0.657	0.559	0.621
224.0	0.670	0.643	0.629	0.656	0.690	0.629	0.656
230.0	0.628	0.607	0.607	0.620	0.643	0.607	0.620
236.0	0.525	0.521	0.518	0.561	0.532	0.518	0.525
240.0	0.521	0.521	0.530	0.533	0.519	0.519	0.521
254.0	0.466	0.493	0.481	0.480	0.488	0.466	0.481
263.0	0.467	0.466	0.465	0.475	0.476	0.465	0.467
282.0	0.488	0.514	0.530	0.524	0.534	0.488	0.524
293.0	0.485	0.491	0.513	0.478	0.487	0.478	0.487
305.0	0.532	0.537	0.512	0.549	0.545	0.512	0.537
312.0	0.544	0.554	0.523	0.552	0.520	0.520	0.544
321.0	0.905	0.872	0.918	0.846	0.914	0.846	0.905
339.0	0.430	0.473	0.396	0.465	0.480	0.396	0.465
350.0	0.432	0.445	0.411	0.418	0.482	0.411	0.432
362.0	0.428	0.422	0.434	0.460	0.451	0.422	0.434
371.0	0.452	0.464	0.437	0.470	0.549	0.437	0.464
383.0	0.434	0.417	0.432	0.426	0.458	0.417	0.432
397.0	0.420	0.424	0.434	0.444	0.448	0.420	0.434
403.0	0.814	0.822	0.857	0.823	0.869	0.814	0.823

AN " L " INDICATES THAT LINER MATERIAL WAS REMAINING AT THAT LOCATION.
THE MEDIAN AND MINIMUM VALUES WERE CALCULATED USING THE PREFIRE THICKNESSES
AT THE LOCATIONS WHERE LINER MATERIAL WAS REMAINING

Table E-XI. RSRM-28A Igniter Chamber and Adapter Insulation Performance

COMPLIANCE SAFETY FACTORS (CSF)

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MINIMUM	PLANE
1.0										
2.0										
3.0										
4.0										
5.0										
6.0										
7.0										
8.0										
9.0										
10.0										
11.0	2.57	2.63	2.61	2.71	2.40	2.63	2.54	2.63	2.40	180.0

SF= + INDICATES THAT NEGLIGIBLE MDD OCCURRED

A BLANK INDICATES NO DATA AVAILABLE FOR THAT STATION

ACTUAL SAFETY FACTORS (ASF)

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MINIMUM	PLANE
1.0										
2.0										
3.0										
4.0										
5.0										
6.0										
7.0										
8.0										
9.0										
10.0										
11.0	3.07	3.14	3.12	3.23	2.87	3.14	3.03	3.14	2.87	180.0

SF= + INDICATES THAT NEGLIGIBLE MDD OCCURRED

A BLANK INDICATES NO DATA AVAILABLE FOR THAT STATION

ORIGINAL PAGE IS OF POOR QUALITY

Table E-XI. RSRM-28A Igniter Chamber and Adapter Insulation Performance (Cont.)

MATERIAL DECOMPOSITION DEPTH (MDD)
(INCHES)

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MEDIAN	MAXIMUM
1.0										
2.0										
3.0										
4.0										
5.0										
6.0										
7.0										
8.0										
9.0										
10.0										
11.0	0.176	0.172	0.173	0.167	0.188	0.172	0.178	0.172	0.173	0.188

A BLANK INDICATES NO DATA AVAILABLE FOR THAT STATION

MATERIAL DECOMPOSITION RATE (MDR)
(MILS/SEC)

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	AVERAGE
1.0									
2.0									
3.0									
4.0									
5.0									
6.0									
7.0									
8.0									
9.0									
10.0									
11.0	1.4	1.4	1.4	1.4	1.5	1.4	1.4	1.4	1.4

MOTOR ACTION (EXPOSURE) TIME = 123.30 SEC

A MDR=0 INDICATES THAT MDR < .1 MIL/SEC

A BLANK INDICATES NO DATA AVAILABLE FOR THAT STATION

Table E-XI. RSRM-28A Igniter Chamber and Adapter Insulation Performance (Cont.)

CHAMBER PART NO. 1U77392-01(902)
CHAMBER SERIAL NO. 0000013
ADAPTER PART NO. 1U75163-03(903)
ADAPTER SERIAL NO. 0000003

PREFIRE MEASUREMENTS
INCHES

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MEDIAN	MINIMUM
1.0										
2.0										
3.0										
4.0										
5.0										
6.0										
7.0										
8.0										
9.0										
10.0										
11.0	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540

A BLANK INDICATES NO DATA WAS TAKEN AT THAT STATION

CHAMBER PART NO. 1U77457-01(903)
CHAMBER SERIAL NO. 0000009
ADAPTER PART NO. 1U75161-02(902)
ADAPTER SERIAL NO. 0000001

POSTFIRE MEASUREMENTS
INCHES

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MEDIAN	MINIMUM
1.0										
2.0										
3.0										
4.0										
5.0										
6.0										
7.0										
8.0										
9.0										
10.0										
11.0	0.364	0.368	0.367	0.373	0.352	0.368	0.362	0.368	0.368	0.352

A BLANK INDICATES NO DATA WAS TAKEN AT THAT STATION

Table E-XII. RSRM-28B Igniter Chamber and Adapter Insulation Performance

COMPLIANCE SAFETY FACTORS (CSF)

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MINIMUM	PLANE
1.0										
2.0										
3.0										
4.0										
5.0										
6.0										
7.0										
8.0										
9.0										
10.0										
11.0	2.72	2.77	2.92	2.63	2.71	2.76	2.76	2.57	2.57	330.0

SF= + INDICATES THAT NEGLIGIBLE MDD OCCURRED

A BLANK INDICATES NO DATA AVAILABLE FOR THAT STATION

ACTUAL SAFETY FACTORS (ASF)

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MINIMUM	PLANE
1.0										
2.0										
3.0										
4.0										
5.0										
6.0										
7.0										
8.0										
9.0										
10.0										
11.0	3.25	3.31	3.48	3.14	3.23	3.29	3.29	3.07	3.07	330.0

SF= + INDICATES THAT NEGLIGIBLE MDD OCCURRED

A BLANK INDICATES NO DATA AVAILABLE FOR THAT STATION

Table E-XII. RSRM-28B Igniter Chamber and Adapter Insulation Performance (Cont.)

MATERIAL DECOMPOSITION DEPTH (MDD)
(INCHES)

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MEDIAN	MAXIMUM
1.0										
2.0										
3.0										
4.0										
5.0										
6.0										
7.0										
8.0										
9.0										
10.0										
11.0	0.166	0.163	0.155	0.172	0.167	0.164	0.164	0.176	0.165	0.176

A BLANK INDICATES NO DATA AVAILABLE FOR THAT STATION

MATERIAL DECOMPOSITION RATE (MDR)
(MILS/SEC)

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	AVERAGE
1.0									
2.0									
3.0									
4.0									
5.0									
6.0									
7.0									
8.0									
9.0									
10.0									
11.0	1.3	1.3	1.3	1.4	1.4	1.3	1.3	1.4	1.3

MOTOR ACTION (EXPOSURE) TIME = 123.60 SEC

A MDR=0 INDICATES THAT MDR < .1 MIL/SEC

A BLANK INDICATES NO DATA AVAILABLE FOR THAT STATION

Table E-XII. RSRM-28B Igniter Chamber and Adapter Insulation Performance (Cont.)

CHAMBER PART NO. 1U77392-01(902)
CHAMBER SERIAL NO. 0000012
ADAPTER PART NO. 1U76163-03(903) PREFIRE MEASUREMENTS
ADAPTER SERIAL NO. 0000004 INCHES

STATION	DEGREE LOCATION									
(NO.)	0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MEDIAN	MINIMUM
1.0										
2.0										
3.0										
4.0										
5.0										
6.0										
7.0										
8.0										
9.0										
10.0										
11.0	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540

A BLANK INDICATES NO DATA WAS TAKEN AT THAT STATION

CHAMBER PART NO. 1U77457-01(903)
CHAMBER SERIAL NO. 0000010
ADAPTER PART NO. 1U75161-02(902) POSTFIRE MEASUREMENTS
ADAPTER SERIAL NO. 0000002 INCHES

STATION	DEGREE LOCATION									
(NO.)	0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MEDIAN	MINIMUM
1.0										
2.0										
3.0										
4.0										
5.0										
6.0										
7.0										
8.0										
9.0										
10.0										
11.0	0.374	0.377	0.385	0.368	0.373	0.376	0.376	0.364	0.375	0.364

A BLANK INDICATES NO DATA WAS TAKEN AT THAT STATION

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